Medications: How do we understand expiration dates?

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Arts in Psychology

at Massey University, Albany, New Zealand

Susan Frankland

2022

Acknowledgements

Words cannot express my gratitude to my professor and supervisor, Dr Kathryn McGuigan, who without her kind words, patience, constant motivation, invaluable knowledge, expertise, and momentous feedback, this journey would not have been possible.

A very special thank you to my wonderful husband George who provided the love, support, time and space I needed to dedicate to this project, and to my daughter Tazyn-Lee, of whom I am extremely grateful for keeping me grounded and focused on the 'one task at a time' attitude and the belief I could do this, even when under pressure herself. I would also like to thank all my other family and friends, who were there when needed. Thanks must also go to God for my faith and the well timed, 'all will be well' rainbows in the sky.

I would be remiss not to recognise and acknowledge the selfless giving of time and personal narratives from the study participants, *Trevor Keam, Anonymous, Hugh Cornwright, Simone Mills, Kathleen Turner, Gunther Hanne, Bobbie McGee, Vea Oneone, Kial Batt, Carl Drake, Aiden Wellborne, Sania Saitala, Felicia Chan, David Easey, Sophie Wan, Colleen Rapson, Dan Zelter, Sam Bonakdar, Nicole Zwarts and Tsz-Ting Fong,* who impacted and inspired me with their wonderful, colourful life experiences and insights.

Abstract

The expectation of the pharmaceutical industry is that medication expiration dates are automatically understood by consumers. There is a complexity to this interpretation that has not been fully studied. The main aim of this research is to explore how prescription medication expiration dates, are understood by the consumer. An in-depth interviewing, narrative method was used to gain valid and detailed discourse of the individuals perspective of why expiry dates are used by pharmaceutical companies, how it influenced their decisions on storage and/or disposal, and individual views on recycling and/or redistribution of excess and/or expired medications to those in need. Twenty people were interviewed, from varied demographics, using a questionnaire guide, consisting of 18 questions, aimed at gaining information on their personal opinions of pharmaceutical expiration dates. The main findings revealed by the narratives, were that medication expiration dates were only an indication of best efficacy and not something that would cause any serious harm. Interestingly, there was no consensus on the types of medications most effected by expiration dates, or which medications the individual would consume after expiry. The analysis showed that most of the subjects would, and had used expired medications at some point, and were not concerned about experiencing any major side effects. It was also found that a high percentage of participants thought the use of expiry dates on medications, to be a marketing strategy by pharmaceutical companies, in order to generate more sales. Knowledge of the process of disposing of expired medications was limited, and only one participant had any knowledge of the concept of programs to redistribute medication. Support for such programs received mixed results. The majority of participants felt that the risk of taking expired medicine was not a concern; however this only applied to the patient themselves and all would not dispense expired medications to another family member, particularly mothers to children. In summary, the findings of this research highlighted the gap in consumer knowledge of

medication expiration dates, the categories of medication most effected by age and for uncovering new ways to examine expired medication for deterioration and efficacy. It was shown that consumers are positive about investigating redistributive programs which could facilitate excess/expired medications reaching those in need and to drastically minimise excessive, current global medication wastage.

Contents

List of Figures and Tables

Chapter 1

Medication: How do we understand expiration dates?

"Before you treat a man with a condition, know that not all cures can heal all people. For the chemistry that works on one patient may not work for the next, because even medicine has its own conditions." (Suzy.Kassem, 2011).

A noteworthy part of a country's healthcare expenditure is comprised of medications, however there is limited research on the economic and environmental impact of expired medications and little on a person's understandings and interpretations of pharmaceutical expiry dates. The continual increase of pharmaceutical consumption and production, has led to a staggering increase in expired medications, adding to the current global medicinal wastage and serious environmental impacts (Azad et al., 2016). Excess and expired medication is a result of numerous factors, such as over prescribing, over dispensing, inappropriate disposal methods and insufficient legislation for medication disposal, mis-conception and misunderstanding of medication expiration dates (Alnahas et al., 2020). There is also limited reviewing of medication life cycles to balance production and consumption and the absence of wider information on the why and how of medication expiry dates (Peake et al., 2016). The high level of global expired medications signifies a problem throughout the supply chain which contributes to medication wastage. This wastage further reduces medications available to patients who already struggle to access or afford appropriate medicines, which ultimately results in deterioration of patient healthcare quality. One way to address this is by creating public awareness of expectations behind expiry dates. In particular, the risks or not of expired medicines, opportunities to recycle and/or redistribute expired medications, and correct disposal practices, should be communicated more effectively to patients and public through healthcare workers, pharmaceuticals, prescribers

and policy makers. This information is lacking or non-existent, even on current packaging or inserts of medicines.

Medicines are more than chemical compounds and more than material things, with their powers underpinned by both social and psychological interactions, and the social lives they 'live' between people (Whyte et al., 2002), from production to 'life after death' (efficacy or disposal). The African traditional healer, who sees medicines as catalysts through which the body can heal itself using herbs and incantations; India's Ayurvedic healers, accept that plants heal in a natural, holistic way; and for some, alternative medicines such as homeopathy are the preferred treatment for their illness or condition. In Aotearoa, New Zealand, traditional healing practices such as Rongoā Māori medicine would include plants and other herbal remedies. Also more holistic models of health and well-being would be important such as Te Whare Tapa Wha (Purdy, 2020). However, for the purpose of this research the focus is on modern prescription medicine, regulated by laws, and specific to New Zealand.

Medicines in New Zealand, are monitored and regulated by various organisations, with New Zealand (NZ) being unique, in that they are the only country in the world to have a government non-profit agency (Pharmac), who decides which medications to fund and also manages a fixed budget for these medicines (Pharmac, 2022a). The agency Medsafe, approves medications and ensures they work as they are intended (Ponen & Lambie, 2016) and all agencies, are legislated by the NZ Medicines Act, 1981, which establishes regulations, to ensure safety and effectiveness, for all medicines, related products, medical devices, and the legislative framework for prescribers and pharmacists, in New Zealand (NZGovernment, 1981).

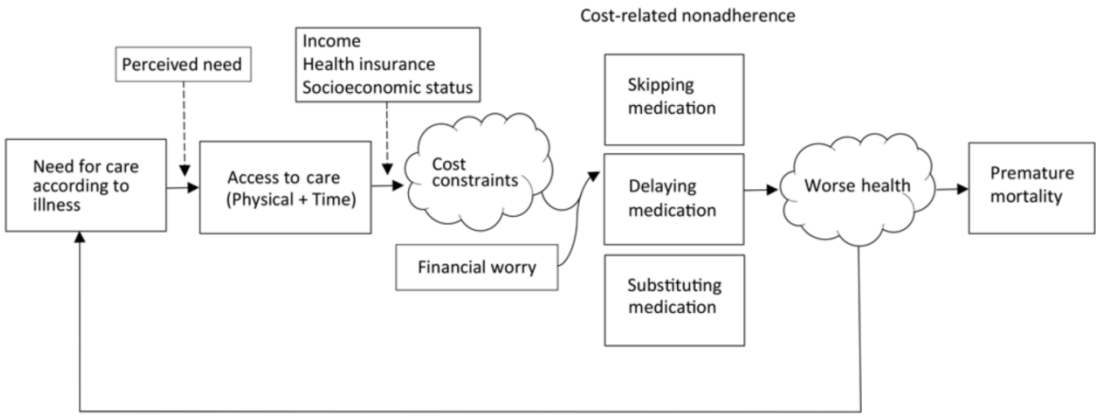
Most people take medicine at some point in their life, whether every day or only when needed. It has a purpose, to treat illness as well as improve health. It has both performative and social effects, in that medicines confirm illness and demonstrate characteristics and intent

of those who administer them (Hwu, 2020). Many aspects of medicines other than their therapeutic function are often overlooked, for example social or emotional effects. Both non-medical and medical effects constitute the medicines total effect. When 'things' enter people's lives they develop a social life and become semiotic (Hwu, 2020).

Van der Geest (2003) describes medicines as a socio-cultural phenomenon and suggests that the therapeutic effect of medicines is accepted, however the effect of many other aspects of medications, such as the economic, social or cultural aspect is often overlooked, all of which contribute to create a total drug effect. When people accept medicines into their lives, the medicines become semiotic and begin their 'social life'. Medicines are a great example of a valuable thing and assume a wide spectrum of meanings far beyond their chemical compounds, and as they become more 'valuable' their semiotic quality increases (van der Geest & Hardon, 2006). For example, mothers in some undeveloped countries, attach a social context which demands the use of medicine. The idea of health or ill health, to these mothers, and how it should be treated is different from the biomedical knowledge. For them, when a child coughs, and continues to be ill, they see this as an opportunity for others to consider them negligent. The husband seeing the child remain ill, may blame the mother and be upset, disrupting the social atmosphere of the home, which is why many manufacturers of cough syrup use a hacking cough in their advertising. This type of advertising not only indicates the issue with the lungs but also the potential for social disruption. Mothers in such a situation may see medicine as the only solution, ignoring the possibility that the child may recover without the use of medicine. In her eyes, the medicines effect is manifold, not only curing the child's illness, but conveying to the world and the family that she is a good mother, whilst simultaneously signalling to the child that the mother cares (van der Geest & Hardon, 2006).

Most western pharmaceutical companies are guilty of disease mongering and promoting their definition of disease to prescribers and consumers, replacing the social construction of illness with a corporate construction of disease. If people think they are ill, there is a lot of money to be made (Moynihan et al., 2002). The participants display social efficacy with regards to their unconscious understanding and response to expired medicines. The 'why' of taking medicine, does not matter to a patient, it is only important that they are comfortable in the knowledge that the medication they are using, is safe, will improve their condition or illness and supply the required social effects, something described by Healy (2012), as pharmageddon. In 2016, $528.4 billion dollars was the US financial pharmaceutical implication, resulting from medication non adherence (Watanabe et al., 2018). The cost related non adherence (CRNA) phenomena is reported by patients to be the reason they share medication, skip doses or do not fill a prescription (Goldsmith et al., 2017). Non adherence to medication is increasing globally, particularly among the elderly, with a strong link between cost constraints and patient mortality (see Figure 1).

Figure 1: ***Relationship between cost-related non-adherence and mortality (Clouds-unmeasurable variables)***



Note: From the Cost related Non-adherence and Mortality measures, 2020, CDC, p1.

Despite popular belief, medicines can be both injurious as well as beneficial, as depicted in the use of the Greek word pharmakon, which has a dual meaning – cure and

poison. People are often unaware, that many medications contain ingredients such as arsenic and mercury and carry risk. Before taking medications, individuals should consider these risks which have the potential to cause adverse effects or interactions if mixed with other medications, alcohol or even certain foods (Liebert & Gavey, 2009). Adverse reactions can also be unique to an individual - medicines are not a 'one size fits all', and is a foremost reason why healthcare pushes the dangers of medication sharing (Beyene et al., 2014) and that risks are greatly reduced, simply by taking medication as directed and correctly (Edelstein, 2015).

The outbreak of the Covid-19 pandemic, caused millions of people to experience lockdowns, quarantines, and social distancing mandated by governments (Bisiada, 2021). This saw a monumental increase in the voice of the people, mostly via social media, to express their fear, panic, concerns, opinions, beliefs and feelings toward this new reality (Wicke & Bolognesi, 2020). Situations in healthcare were dire, with overcrowding in hospitals, and many chronic patients, having their healthcare routines delayed, limited and even halted. The most focused area of discourse was around the spread and treatment of the virus and the urgency to find a vaccine. The pandemic strained not only hospital resources, but personal protective equipment (PPE) supplies, and medication (Sen-Crowe et al., 2021). World discourse was focused on shortages of particular medicines. In context, the period 2015-2019, saw medication shortages consistently increase, from five categories of medicines to 31 categories (Acosta et al., 2019). However, 87% of these medicines were confirmed and reported over a period of 6 months in 2020, half the time of those reported in 2019 (Sen-Crowe et al., 2021). Drug shortages have a severe impact on patient outcomes, resulting in negative patient, economic, clinical and humanistic outcomes, and these were anticipated to worsen during the pandemic. The Covid-19 and vaccine centric focus, although understandable, caused the world to 'overlook or put to the side' perspective, with regards to

other illnesses requiring medication, posing a threat to the health and safety of patients that did not have Covid-19 (Choo & Rajkumar, 2020). Discourses among lay people and the health industry, were anticipating and predicting shortages, with lay persons reacting, without the appropriate or correct knowledge, as seen in the anxiety induced, panic buying behaviour. Conversations around this sudden fear of shortage, divided the sentiments of the public between negative and positive responses, with most of the panic buyers not been able to give a quantified reason for their actions (Leung et al., 2021). With dystopian fiction preparing the world for all sorts of apocalypses (one being deadly plagues), this consumer behaviour did not come as a surprise (Leung et al., 2021).

Hoarding was increasing and becoming a pandemic in itself, with many off-label (a drug approved to treat a condition different than the patients' presented condition), becoming difficult to obtain due to public and scientific enthusiasm for Covid-19 therapies (Mendel et al., 2021). Hydroxychloroquine was in short supply, and unobtainable for many patients who needed the drug to treat rheumatoid arthritis and other autoimmune conditions (Phuong et al., 2019). Sedative shortages, such as propofol, not only impact patients who are seriously ill with Covid-19, but those with respiratory failure due to other causes, in need of critical care like mechanical ventilation, or those requiring emergency surgeries under general anaesthesia (Johnson, 2011). Policy makers demand solutions for those cases where the populations' health is affected by episodes of drug shortages and although the FDA could cite understanding of the significant impacts it was having on patient care, they could offer no immediate solution other than to state "*it was doing everything possible, within its authority to alleviate and help prevent shortage*" (FDA, 2020).

Among these issues, central to discussions was treatment and containment of the Covid-19 virus itself. Covid-19 vaccines, were not classified as a prescription medication, however they fit within the scope of this research, in that, for a patient request to 'mix'

vaccines (if the primary dose was different to the second dose or booster), a medical prescription was required (MOHNZ, 2021a). An approved vaccine, brought with it more public awareness of the lifecycle and care of medicines, placing pharmaceutical manufacturers centre stage in the public eye, in particular Pfizer, a company who, prior to the Covid-19 pandemic, (although being one of the world leaders in biopharmaceuticals), the general public were mostly unaware of. The vaccines also brought awareness about medication and delicate chemical makeup, with the Covid-19 vaccine having special and specific storage requirements (had to be kept at 2°C-8°C (36°F-46°F). The arrival of a vaccine brought reduction in public anxiety, increased confidence in the fight against Covid-19 and delivered immense hope, but there was still a large amount of people who were either 'vax' hesitant or even anti-vaccination altogether. One survey found that almost one in six people in the UK, and one in three in the US and NZ, would refuse a vaccine (Boyd, 2021). Sociological work has demonstrated how the perception of the general public can be inaccurate with regards to science (Entradas, 2015), as some people tend to see science free from the influence of personal values (Boyd, 2021) which influences scepticism. In most of the population, despite scepticism regarding vaccines, there is a general agreement that vaccines other than the Covid-19 vaccine, such as the measles, mumps, rubella (MMR) vaccine is safe and effective (Deer, 2011). It is felt, the reason for this shift in trust, is that parents today who are considering vaccination for their children can receive definite answers as to the best course of action from doctors, which was not the case with the Covid-19 vaccine, where people were seeing the scientific process play out in real time (Boyd, 2021) whilst experiencing the fallibility of such process. A good example of this, is the information surrounding the wearing of a face mask (McNaughton-Cassill, 2020), with a significant amount of discourse regarding their efficacy in preventing the spread of the virus. Different governments were indecisive with their mandates. For example, the US initially ordered

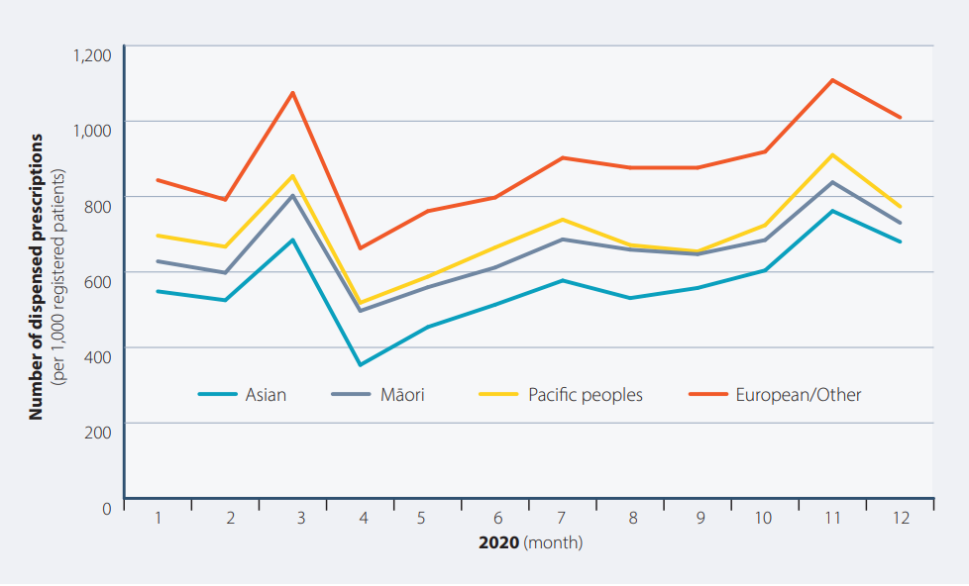
social distancing rather than face mask wearing, and later changed their advice and recommended the wearing of face masks in public places. When authority is indecisive, it reflects on the acquisition of scientific evidence and the need for revision of hypotheses (Calnan & Sanford, 2004). With a tremendous amount of conflicting information about Covid-19, such as daily updates, constant change in theories and precautionary measures, science's fallible nature was on full public display. When science does not have a confident theory, it increases scepticism (Boyd, 2021) and presents another reason to distrust science and reject 'expert' advice, as the public consider themselves to be well informed from all the information available to them. The sociology of science is complex (Calnan & Sanford, 2004), and presenting people with a consensus on certain views of the scientific community, is unlikely to change a sceptics mind (Boyd, 2021) as it does not show engagement with concerns and beliefs of the recipient, and empowers conspiracy theorists (Sayin & Bozkurt, 2021).

Reflecting the same time period in 2020/2021, 49,580,142 prescribed medications, were dispensed to consumers in New Zealand. This figure excludes hospital dispensed medications (Pharmac, 2022b), although 1.2 million publicly funded hospital discharges were reported in the same year (MOHNZ, 2021b). Dispensing rates in March 2020 were higher than for the same period, in the previous four years, with Pharmacies dispensing 1,0008,418 more prescription medications, than in March 2019. This increase in medicine consumption, was followed by a decrease in April 2020 with only 750,890 prescription medicines being dispensed, than for the same period in 2019 (BPACNz, 2021b). It is reported that a possible cause for this increase was stockpiling of medicines prior to the national lockdown as well as panic buying (Arafat et al., 2020). The consumption of medicines continued to increase at a steady pace until August 2020, when it was at the same level of dispensing as August 2019. There was a marked increase again in November 2020, which was higher than the previous

years and said to have been due to patients ‘pausing’ their normal medication regimens earlier in the year, and reverting back to them later in the same year (Fife, 2020). Dispensing fluctuations for March and April 2020, were possibly influenced by the national lockdown due to the Covid-19 pandemic influencing dispensing patterns, a reduction in other infectious diseases, attributed to better hygiene practices to prevent disease transmission, such as social distancing and wearing of face masks, compounded with the high uptake of flu vaccinations (Lee & Lin, 2020).

Although 2019-2020 saw dispensing rates remain similar across all ethnic groups; the dispensing rates, after the lockdown, did not recuperate to the same degree for Māori, Pasifika and Asian groups as it did for European and Others, compared to 2019, see Figure 2 (BPACNz, 2021a).

Figure 2: ***Number of dispensed prescriptions (per 1,000 registered patients) from community pharmacies in New Zealand by ethnicity, by month in 2020.***



Note: From the National dispensing overview, 2022, BPAC^{nz}*, p 4.*

Covid-19 also increased the healthcare imbalance between the ethnic groups (BPACNz, 2021a), as was seen in the lower resumption of preventative medicines after 2020; however this has been thought to be predominantly due to people not presenting as normal to primary care for diagnosis and/or not needing specific medicines, such as antibiotics. Paradoxically,

it has been suggested that the pandemic equally, together with more public education on antimicrobial stewardship (AMS), highlighted the limitations of antibiotics (PSNZ, 2021).

Multimorbidity is the someone living with two or more conditions. This is on the increase; effecting 1 in 4 NZ adults within the 64-75 year age group, accounting for the largest sector of multi-morbidity (MOHNZ, 2022). An aging population together with multimorbidity drives polypharmacy (the use of multiple medicines), with 9.93% of the New Zealand population poly-medicating (using more than five medicines), and 1.92% concomitant with hyper-polypharmacy (more than 10+ medicines) (see Table 1), (Nind et al., 2021). In turn, these conditions lead to an increase in medication taking and pharmaceutical spend.

Table 1: ***Long Term Medication Polypharmacy- StatsNZ, p2.***

Age	**5+ long term Medications**	**11+ long term medications**
65+	35%	1.24%
85+	56.6%	

The pharmaceutical spend in New Zealand (population of 5,084,300) was $6,797.49 per capita in 2019, a total of $34,560,529,250 for the year. In comparison to the United Kingdom (UK) who have a population 10 times that of New Zealand, who spent $6,962.04 per capita (MacroTrends, 2022), medication spend is high. Much of this consumed by replenishing of expired medicines, or replenishing of medicines due to a misconception of what medication expiry dates mean. New Zealand dumps $40 million dollars of unused medication into landfills each year (Scott, 2021).

There is evidence to suggest that most people are under some mis-conception of why medication expiry dates exist and have a complex view on what these dates mean. Current research into comprehending how people perceive expiry dates is limited, if not non-existent,

but I suspect, understanding about these dates, their meaning, and protocols, is mostly learned, passed down from families, and unquestioned, which may often lead to incorrect medication behaviour. The use of expiration dates by pharmaceutical companies or pharmacists is as controversial as the understanding; as seen in the following quote by Dr Francis Flaherty, a former director for the US Food and Drug Administration (FDA) testing program, who conducted research on over 100 prescription and over-the-counter (OTC) drugs, to investigate whether medicines could be extended past expiration date. *"The expiration date doesn't mean, or even suggest, that the drug will stop being effective after that, nor that it will become harmful. Manufacturers put expiration dates on for marketing, rather than scientific, reasons. It is not profitable for them to have products on a shelf for 10 years. They want turnover"* (Francis Flaherty, 1986, p. 47).

Research Aims

My research aims to investigate how medication expiry dates are understood by lay people, how this affects their adherence or non-adherence to medication regimens, storage, disposal and recycling or redistribution of medicines. Although most people are aware that medicines carry an expiry date, it appears they rarely take notice of these dates, when purchasing, storing, using or dispensing medications on a personal level. I am interested in the personal narratives of individuals regarding their understanding and experiences regarding the reasons they adhere to or ignore expiration dates; what effect this has on how they store or dispose of medicines and whether it has any influence on their decision to support or not support, pharmaceutical redistributive programs.

The focus of this research is on patient understandings of prescription medications; to initially look at the patients natural process when receiving medication from the pharmacist. How a patient decides what is important information regarding their prescription medicines, in particular expiration dates, and if they acknowledge, adhere to or ignore these dates and

the reasons they do so. It then moves on to patient views and understanding regarding the medicine's expiry dates, focussing on how each patient is affected by this understanding, with special regard to the different categories of medication and the influence expiration dates have on how patients treat, use and dispose of medication. It will also touch on attitudes towards programmes to recycle and redistribute medications to those in need. The aim is to determine if medication adherence could be improved and wastage could be minimised, by better patient understanding of expired medicines, in addition to how this new knowledge, could contribute to the initiation or improvement of recycling and redistribution programs, to assist those who cannot afford or get access to medicines.

Chapter 2

Literature Review

Medication Complex Lifestyles

Medicines have complex life cycles, and none of the stages are interrelated, but are interdependent. The most important stage of a medicine's life cycle is the final stage where a patient fills a prescription and takes responsibility for the medication. It is important that the product information and label indicate the dosage, when to take the medicine and the date it expires. However, often there is no information on what an expiration date means, or what to do when a medication expires (e.g. how to dispose of safely). The pharmaceutical industry has left this phase of a medicine's 'life cycle', open to human error and ambiguity. Within the social world, medicines interact with social actors, and present different expectations to different people, at different phases (van der Geest & Hardon, 2006). In the development phase, a pharmaceutical company may represent value with expectations of profit; the scientist may represent pride, expecting to develop breakthrough medicines that will promote health and wellbeing (Cunningham, 2017); the pharmacist or dispenser has hope that the patient will take the medication as instructed; and finally, the patient has trust that the doctor diagnosed the illness or condition correctly, that the pharmacist dispensed the correct medicine, dosage and instruction on how and when to use the dispensed medicine and trust that the medicine prescribed will treat the condition or illness effectively. Therefore, a medicines life cycle, could end at disposal on adherence to the medicines expiry date; or could continue, if expiration dates are ignored; similar to providing a cake recipe, but not providing details on how long to bake for.

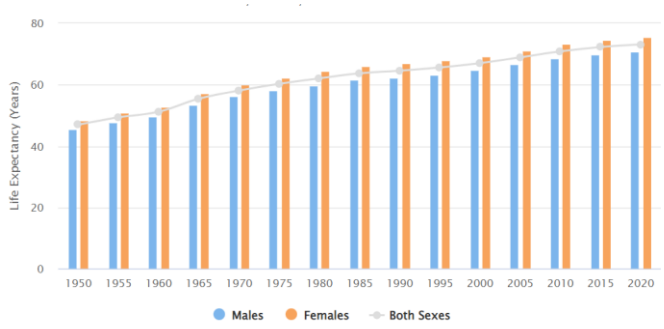
Changes in Usage Patterns

Health policymakers put extreme effort into securing some form of certainty, that people will use medicines in a sensible manner, with the WHO defining rational use as,

"*patients receive the appropriate medicines, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost both to them and the community*" (Dawood et al., 2016). It is fundamentally expected that patients receive appropriate, clear information when receiving medicines, as few patients adhere to 'controls' set in place by the pharmaceutical companies and/or pharmacists, with little regard for the risk or the possibility of no therapeutic benefit from the medicines, and in some cases suffering problematic outcomes.

Currently, there is a global increase in the use of pharmaceutical medicinal products with some medications in particular seeing a substantial rise in popularity. In the United States of America (USA), pain medication consumption increased 4.9% in 2020 compared to 2019, with three major drugs driving this increase, (adalimumab (Tichy et al., 2021), a drug used in the treatment of arthritis; apixaban (anticoagulant) and an synthesised form of insulin (insulin gargline) (Dunn et al., 2003). In NZ there is a substantial rise in the use of attention-deficit-hyperactivity-disorder (ADHD) medications, that almost doubled in the period 2007-2017, from 516 per 100,000 to 996 per 100,000 units (D'Souz et al., 2020). The average world life expectancy is increasing, (Figure 3) (UN, 2022), and people are living longer, therefore medication usage patterns are continuously changing, particularly among the older world population (medicine use was highest for patients >=85 years in all anatomical classes).

Figure 3: Global Life Expectancy 1950 - 2021



Note: From Macrotrends, 2022, p1.

Studies show a marked increase in medicine prescribing and usage, particularly in multimorbidity of polypharmic people aged 65+ (Barnett et al., 2012), now the median in this age group. The findings of Barnett et al., (2012), highlight the current gap in regular patient medication reviews becoming 'usual care' for older high risk people. Hughes (2004) argues that in spite of increased knowledge and increased responsibility for their own care, patients still fail to follow the recommendations given by health care providers about medication use and McCaffery (2011, p. 947), asks; *"Why would someone who has gone to the trouble and expense of seeking out a physician, of undertaking arduous or uncomfortable tests and other diagnostic procedures, and of purchasing drugs and devices on the advice of the physician, fail to follow the recommendations?"*

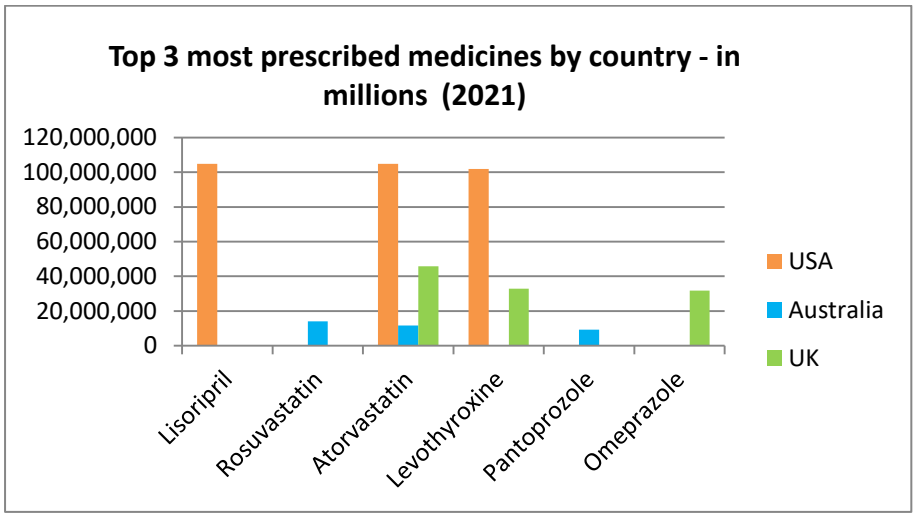
While there is no simple answer to this question, research suggests that there are common factors to the action. A further, increasingly popular contribution to trends of changes in usage patterns, is self-diagnosis encouraged by the arrival of the internet and 'Dr Google', which has led to health related information being available to even the lay public leading to more self-diagnosis and to a large extent, self-medication and not always to the benefit of the patient (Agarwal, 2020).

Prescriptions for Adults

Almost seven out of 10 adults (18 years plus), in the USA, use at least one prescription drug, 69% of the US population, and 1-in-5 take at least five prescription drugs (Gould & Mitty, 2010). A concern is that pharmaceutical studies tend to use young, healthy individuals to determine the information of effectiveness, dosage and adverse effects of a medicine. This is problematic because the resulting information may not crossover to older adults, due to older bodies processing medications differently to younger ones, and absorption rates and exiting methods, are different. Any change that interferes or decreases

the breakdown or removal ability of the body, to remove medicines from the system, may result in medications staying in the body longer, and possibly indicating lower dosing needs or even a switch to safer medication (Gould & Mitty, 2010). Older adults also tend to have more multimorbidity and polypharmacy, making it further problematic to assess for multiple medication effects, as one medicine for one ailment, may make another ailment worse. Hales et al., (2019) found that the most commonly used drugs in the 40-59 age group are anti-depressants, statins, proton pump inhibitors and analgesics, and the 60-79 age group most commonly use statins, type I and II diabetic medicines and beta blockers. Despite similar demographics Tomlin et al., (2020), found a difference of most commonly used medications in NZ, across all age groups. In NZ, the most commonly used therapeutic medicines are anti-bacterial; sleep medication and analgesics with the most commonly prescribed types of medications being paracetemol, codeine phosphate, and zopiclone (used to treat sleep problems) (Tomlin et al., 2020). NZ also has an increasing and concerning polypharmacy issue, particularly in the 55-85 year age group, in line with multimorbidity and polypharmacy as a growing global problem (Kim & Parish, 2017). It is estimated 38 million seniors in the USA being polypharmic, and expectations of it reaching 75 million by the year 2030 (Mair et al., 2017). It is noteworthy, that the top three medicines dispensed in the USA, Australia and UK in 2021 have similarities in the type of medicine dispensed however not necessarily for the same condition (shown in Figure 4).

Figure 4: ***Most commonly prescribed medications, by country, 2021, in millions***



Note: Data from Statista.com – 2021, p1.

Adult prescription medicating is problematic for the physician, if the patient is double doctoring (seeing multiple physicians), and/or has multi-morbidity or is polypharmic. Doctors need to be vigilant when treating patients, as some may be presenting another family members 'symptoms' to obtain a prescription (Hodgetts et al., 2011). Non-adherence and noncompliance is multi-factorial and a worldwide healthcare concern; it is claimed that one in five prescriptions are never filled, with the main reason identified as money, and one study showing that nine out of 22 patients, after receiving a prescription, found their medicine cheaper over-the-counter (Schwartz et al., 2015). There are factors other than cost, such as the quality of doctor-patient relationships and communication, (when the patient may misunderstand verbal instructions for medication use), which often result in noncompliance; and even a patients' desire to maintain control over the condition (Hanchak et al., 1996). A significant concern is that many doctors find when issuing a prescription, it takes up to three verbal repeat of instructions, for a patient to get a clear understanding of medication information (Safeer & Keenan, 2005). Whatever the reason, noncompliance and non-adherence to medication negatively affects the safety and efficacy of medicines and the cost of therapy.

Prescriptions for Children

Global prescribing trends indicate a marked increase in pharmacological interventions for children and it is raising concerns about not only the prescribing of appropriate medication, but the amount. With new drugs continually entering the pharmaceutical market, Dr Florence Bourgeois claims, "*that in excess of 50% of all drugs approved by the FDA, lack information on how to effectively and safely use the drug in children*" (Bourgeois et al., 2010). Dr Bourgeois, goes on to question the lack of evidence that is often available for medication use guidance in children, with concerns that the FDA has well established processes to ensure adult medicine safety and effectiveness, but is historically lacking for children (Bourgeois et al., 2013). It has been found that 0-5 year old children are at the greatest risk for adverse exposures and poisonings from medicines prescribed for adults, with hypoglycaemic medication accounting for 60.1% of all emergency hospital visits, 19.5% of all serious injuries and 49.4% of paediatric hospitalisations (Burghardt et al., 2013).

Globally, respiratory disorders are also increasing, with lower immunities, more exposure to various allergens and pollution driving the intensification of the disorder. Currently, chronic obstructive pulmonary disorder (COPD), is the third leading cause of death globally, a major contributor to the global paediatric healthcare burden and the reason for increasing demand for efficient treatment of the disease (Bourgeois et al., 2013), which ironically fuels the drug production market. The growing prevalence of COPD among children, is expected to account for the largest share of the paediatric medicines market in the next two years.

Not surprisingly, paediatric prescribing as a whole, is on the increase, appearing to follow both the trend of a disease and the introduction and promotion of new medications to treat the illness. This is despite the fact that at times a diagnosis does not always necessitate prescription medication, and often physicians do not look past the 'popular' drug solution to

consider alternative conventional options (Darling, 2010). This is evident, in Japan, where prescribing trends show, that with the introduction of desmopressin, a drug produced to target diabetes, there was a marked increase in pharmacological prescribing by doctors in the treatment of nocturnal enuresis (NE) in children (Darling, 2010; Kasamo et al., 2021), from 10.2% in 2015 to 15.3% in 2019. For the same condition, Korea and Australia both saw a 4.7% increase and 14.6% in Germany of administered medication (Kasamo et al., 2021). Most research supports the use of desmopressin for NE, however there is conflicting information. For example, Radmayr et al., (2001) studied 40 children, five plus years of age, diagnosed as continuous bedwetters. The children were divided into two groups, one receiving desmopressin and the other laser acupuncture. After six months, evaluation of the children showed a 75% success rate and a 10% reduction in half of the children using desmopressin compared to 65% success, and 10% reduction in those who underwent laser acupuncture. The study also showed that laser acupuncture as a monotherapy, should be a consideration as an alternative non-invasive, painless and cost effective treatment of primary NE. However, a similar study by Bower and Diao (2021) of 41 cases of childhood NE, 13 of which were combination treatment, found that acupuncture as a combined treatment to be more effective than acupuncture as a monotherapy.

Attention-deficit-hyperactivity (ADHD) is another condition which raises concern in prescribing practices in children and adolescents. In the United States 11% of all children, ages four to 17 years of age, have a diagnosis of ADHD (Panther et al., 2017) and around three out four children, ages 2-17 years, receive ADHD prescription medication with 23% of children recognised with ADHD, not receiving any behaviour or medication treatment at all (Bitsko et al., 2022). Despite the rhetoric and concurrence that the preferred primary treatment approach, for childhood ADHD is non-pharmacological treatment, therapeutic medication dispensing has more than doubled in NZ, without any evidence of ADHD itself

increasing over the same time period. Also evident, is that some children in NZ, although diagnosed with ADHD, do not necessarily need medication (D'Souz et al., 2020) and similar patterns are seen internationally. In most cases, prescribing is an outcome of diagnosis, making it imperative that the clinician also listens carefully to the language of the child to fully understand the experience from the child's perspective (Vaughn & Chopra, 2017). A young child with ADHD, for example, may be very young, and lack the ability and understanding to fully describe their feelings, which could result in a mis-diagnosis and or a more challenging task of managing the disorder. Further areas of paediatric prescribing concern are antibiotic prescribing for children aged 0-4 years, which is currently at its highest since 2017. In NZ, since the 1990's, there has been a steady increase in the amount of prescribed paediatric anti-depressants. In 2015, NZ had the 10th highest anti-depressant use of the 34 OECD nations (Nicholas Bowden et al., 2019), with an 83% increase in anti-depressant consumption for the 13-17 age group (N Bowden et al., 2019).

Children are not surprisingly a complex group of patients who are at greater risk of medication errors, even though they are often reliant on parents or carers to administer their medicines. In a US study many children were found to be left to administer their own medications, particularly beta-agonists (asthma), even though children had only basic knowledge of their medicines (Boztepe et al., 2016). Medication errors (MEs) are a recognised problem (Banning, 2006), and paediatric medication errors — more specifically, prescribing errors — are some of the most important threats to patient safety in children (Conn et al., 2021) with around 13% of paediatric prescriptions resulting in children being readmitted to hospital due to medication errors (Rishoej et al., 2017). The WHO supports these concerns, calling for a reduction in medication-related harm (Conn et al., 2021) while Medsafe NZ acknowledges that many paediatric medication errors and/or adverse reactions are preventable. Studies show that 26.1% of children in primary care, in the United Kingdom

(UK), received prescribed medicine, 75-85% of which had been found to have errors relating to dosage, indicating that almost 22% of children in primary care received incorrect prescriptions (Conn et al., 2021).

A prominent area of most medication errors for paediatric care occurs at the stage of administering the dosage although errors can occur anywhere from prescription to dispensing (Boztepe et al., 2016). Boztepe et al., found that children in the same family may be receiving the same medication, but may be of different ages and require different doses. They also found that many parents simply do not use the correct measuring device (oral syringe, measuring cups), or they administer medicines at incorrect intervals. Nearly 50% of parents surveyed stated that they used a household spoon for liquid medicines; 54% added it to the child's food, if the child refused to take medication; 20.7% of parents or caregivers delayed treatment due to refusal to take tablets and 29.1% delayed treatment for those who would not take liquid medicines (Boztepe et al., 2016). Many parents or carers are often unsure of how much medication to give a child even if the suggested dosage is on the product label, and the manufacturer cannot cover all factors that could contribute to adverse reactions due to incorrect dosage. Prescribed doses of medication for children are generally calculated by age, however with increasing childhood obesity, basing the dosage on age could result in suboptimal therapeutic outcomes (Wade & Martinez, 2022). All of these factors, highlight an area of concern and a significant need for education to those who administer medication to children, in an attempt to reduce medication error.

With emphasis on paediatric medication efficacy, medication adherence in children is no better than that of adults (Matsui, 2007). Given that non-adherence to medicine is correlated to non-achievement of desired treatment result, it is necessary to try to improve adherence by identifying barriers which prevent continuance and completion, of prescribed medication routines. Paediatric medicating has some unique challenges, some of which

include family, and lack of appropriate drug prescribing. Matsui (2007) found research participants felt that medication for treatment of a chronic condition is costly and the expiration dates of the medicine is too short. For this reason they investigated alternative medicine options. It is clear there is a necessity, for intervention strategies, particularly for paediatric prescribing, to improve knowledge around medicines in order to ensure medication adherence and to minimise ME's.

Cultural differences and understandings

Culturally competent healthcare for diverse ethnic groups and people from different cultures requires physicians to firstly understand what culture is, (unique behaviours, lifestyles, beliefs, views and values, shared by groups of people that distinguishes them from others, passed from generation to generation) (Tseng & Streltzer, 2008). Culture has a tremendous impact and influence on how illness is perceived, the relationship between the patient and the healthcare provider, whether or not to accept prescription medication and even the decision to adhere or not to the medication regimen (McQuaid & Landier, 2018). People from different cultural groups may have different views and beliefs about health, sickness and medication and consequently may approach health and illness differently (Metcalfe et al., 2013). Identifying cultural background for the physician, is not an easy task, and can be problematic because cultural impact is not always a conscious action and often amorphous, with cultural change happening through different generations and time (Tseng & Streltzer, 2008). Language and narrative is one of the major ways in which culture is expressed and shared, and a person uses language to communicate not only semantic meanings but underlying attitudes and conceptions which can be very different between different cultural systems; and understanding another person's culture through language can be challenging, particularly when the language is different from one's own (Almutairi, 2015).

A study in Japan, found that young Asian women, regardless of education or family history of cancer, were less likely than European young women to perform self-breast exams or undergo cervical screening. This could be due to Asian women being more sexually modest and experiencing less utilisation of western healthcare (Tang et al., 1999). Seifu and Mekonen (2021) reported similar findings in their study of self-breast examination and awareness in Africa, dividing the participants by region into West, East, North, Central and South Africa. Interestingly, the study showed in South Africa, seen as the 'bread basket' of Africa and considered a developed country, that the highest prevalence of regular breast exam to be in West Africa (58.87%) and the lowest in South Africa (5.33%). Sung (1999) in a self-report study of 500 undergraduate students in the UK (identifying as Asian or European), found a significant relationship between a person's cultural background and beliefs regarding benefits and dangers of medication. Students of Asian culture expressed more negative understandings and perceptions, such as, medicines are essentially harmful and to be avoided (Horne et al., 2004), than those of European culture; however no notable relationship between cultural background and perceptions of personal reactivity to medicine (Graupner et al., 2004), nor any stance on how physicians use medication was found. Overall between both cultural groups, experience of medicine intake was positive, but students identifying with a European cultural background where found to have considerably more experience with prescribed medicines than those of Asian cultural background (Sung, 1999).

New Zealand has a rich diversity of ethnicities, a mix of Western and Indigenous influences (StatsNZ, 2020) and any contemporary physician in Aotearoa, should acknowledge the importance of cultural factors and needs to have or develop some understanding and skills of working with Māori patients, if they want to ensure healthcare compliance and adherence and ultimately achieve better health outcomes (Pomare & Ngata, 1992). The result of physicians not having the skills to work with people of a different

cultural background, could be projected to the patient as disrespect or indifference, and result in a lack of confidence in the doctor and Western therapy (Horne et al., 2004). Such occurrences could leave the patient with a bad experience, which they may relay to others, continuing the cycle of distrust in western healthcare practices.

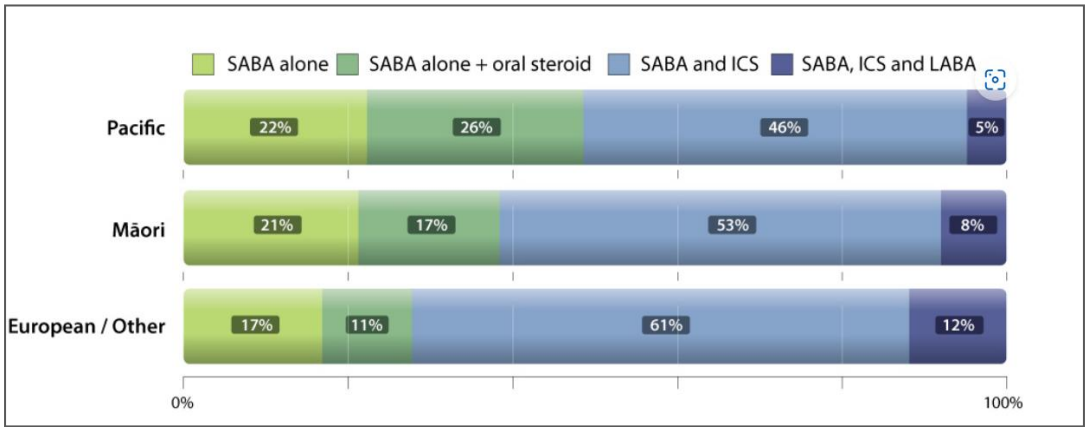
Currently, approximately 80% of the developing world's rural population depend on traditional medicine for primary healthcare needs. It's popularity is increasing, its use is spreading among urban populations in many western countries, and it is promoted internationally by the WHO, since the late 1970's (Ahuriri-Driscoll et al., 2008). One of the important arts of modern medical practice should be to bring the benefits and advantages of modern medicine alongside traditional health and healing practices, so that 'health and sickness' are done with and alongside people, rather than to them (Pomare & Ngata, 1992). In NZ, many approaches to integrate traditional Māori medicine with conventional medicine have been outlined, based on upholding the integrity of Rongoā Māori and respecting it as a taongā (treasured possession), while also acknowledging its contribution to improving health. Combining traditional healing and western medical approaches is increasingly common in the NZ health sector, as it strives, to be more responsive and accessible to Māori. Māori people, like many other groups, regard these cultural factors as an integral part of any healing practice and therefore any attempt to understand the cultural factors in medicine taking should consider certain cultural principles, and ethno-pharmacology, in the delivery of health care (Pomare & Ngata, 1992), (as shown in Table 2).

Table 2: ***Practical points in understanding the cultural implications of drug therapy*****,** ***New Ethicals, 1992, p1.***

Acknowledge the importance of the concept of 'culture' .
Acknowledge that different groups 'see' and 'co' health differently and use alternative healing practices and remedies
Give alternative health and healing practices equal value and respect
Recognise that the context and place of healing is important and that a healer goes with traditional practices
Realise that medical practitioners are healers too
Recognise that one of the arts of medical practice is to bring modern practical therapeutics alongside traditional healing practices
Ensure that therapeutic regimens 'start with people as they are and a community as it is'
Remember that what works for people is important

Patterns of prescriptions dispensed to Māori and Pasifika, are similar to that of non-Māori, with a noticeable difference in categories of conditions and medicines such as Māori using more asthma medication than other cultures in NZ. Regardless of condition, Māori had 19–37% lower dispensing overall than non-Māori, of nearly 1 million scripts (Metcalfe et al., 2013). Repeat prescriptions were less likely for Māori who also access medicines less than non- Māori.

Figure 5: Dispensed medicines relating to each asthma management



Note: From Ethnic disparities in asthma treatment, NLM, 2021, p2.

With medical care considered one of the most basic of all human needs (Linnard-Palmer & Kools, 2004) and the differences identified between cultural groups, suggests there is a need for better acknowledgement and understanding of the effect that culture has on medicine usage, prescription medication adherence and for the provision of correct and appropriate patient information on medications (Horne et al., 2004).

Knowledge about medication

Contemporary health care is a rapid and frequently changing environment, and it is essential that leaders wanting effective transformational change, understand how individuals acclimate and respond to such change in health information and care (Beasley et al., 2021). As new medicines are developed, and more pharmaceuticals vie for the legal drug market share, medicine moves away from its original purpose and becomes more focused on profit. Pharmaceutical companies influence prescribing practices with their targeted marketing to doctors and primary care (Narendran & Narendranathan, 2013), and they can no longer rely solely on medical facts and data such as efficacy and safety. There is increased competition to be or remain the pharmaceutical of choice, primarily due to intensifying, industry competition, with more OTC drugs being sold, and increasing amounts of alternative and complimentary medicines (CAM) being utilised by individuals (Al-Ghanem, 2021). Brand equity is equally becoming more important than ever to the pharmaceutical industry who is following the effective strategies proven in the fast-moving consumer goods (FMCG) industry, to differentiate their products and extend medication life cycles (Basile, 2019). Workneh et al., (2016) found that prescribing decisions by doctors are influenced by strong relevant brands with a favourable reputation. Yeoman (2017) argues that pharmaceutical companies need to become more patient centric when developing medicines for the future, as it is felt that pharmaceutical manufacturers are not understanding what this means. Yeoman also asserts that if consensus is not reached on what it means to be patient centric or the

principles it entails, then the medication producing industry is intent to fail. Yeoman (2017) goes on to claim that patients' views, needs, and priorities need to be meaningfully incorporated into the medication production cycle, as they often stop taking medicine as prescribed, resulting in increasing noncompliance, and poor adherence. Du Plessis et al., (2107) supports this, finding that medications need to become more meaningful to patients to correct the pattern of medication non-adherence. This includes the patient receiving the correct information about medications, including the meaning of expiration dates, disposal processes and practices of recycling, to enable them to make informed adherence decisions. It is also felt that the pharmaceutical industry needs to change their cultural mindset and increase public trust (du Plessis et al., 2017), as a patient centric pharmaceutical manufacturer, will assist in patients engaging more effectively with their disease and improve medication adherence (Philliion, 2021).

Generic vs branded medication understandings

Once the patent of a brand name medicine expires, other manufacturers may produce the same product, without licence (Manzoli et al., 2016). As global healthcare expenditure continues to increase, generic medicine prescribing is encouraged as a measure to contain cost; however although generic medicines are considered to be substantially cheaper than a brand name, this is not always the case and can differ significantly from country to country (Simoens, 2007), due to factors such as currency, country and even the price charged by a manufacturer or pharmacist (Wouters & Kanavos, 2017).

The FDA reported that a generic medicine could be as much as 80%-85% lower than the branded product, a consumer saving of $8 - $10 billion annually (Reuben, 2008) yet, a significant amount of doctors, lay people and pharmacists, still hold negative perceptions of generic medicine, presenting further barriers to the wider expansion of the use of such products (Colgan et al., 2015). Generic prescribing already accounts for 70% of prescriptions

dispensed in the USA and 83% in the UK, yet there is still patient concern, with some studies showing that many patients do not perceive a generic drug to have the same potency or efficacy as the brand name medicine (nocebo effect) (Desai et al., 2019). In fact many patients feel some generic medicines will not work at all (Straka et al., 2017).

However, it is widely accepted, that generic switching gives patients similar therapeutic benefits at considerably lower costs, without compromising healthcare quality (Al-Arifi, 2021). A major problem with generic medication is that it often marketed differently to the branded product – in colour, shape or size and even taste or smell, which increases anxiety and confusion among some patient populations. Generally, people think and treat medicine as they would food or personal products, and value them in the same way, based on past experience; a 'you get what you pay for' attitude, for example the consensus that value brand coffee may not taste the same as the branded product (Singal et al., 2011).

Indeed, for those patients who accept the switch to generic medication, these significant differences could impact adherence and therefore interfere with a patient's normal medication routine and have impact on clinical outcomes (Straka et al., 2017). A key factor to improving confidence in generic products is through education and information on the equivalency of these medicines to brand name products and dispelling generic medicine myths (Dunne & Dunne, 2015), such as they are cheaper so they must be inferior. It has also been found that the trust a patient has in a physician and the attitudes of pharmacists, were strong influencing factors in positive generic drug promotion and confidence, and may overrule a patient's mistrust of generic medications (Virdi et al., 2021). Policymakers should focus on these influencing factors to promote confidence in generic medicines.

Adherence, compliance and medications

Worldwide, medication use is increasingly high, with non-adherence to prescription medication in adults an ongoing public health issue, as treating chronic illness most often

involves continuous use of pharmacotherapy. The medications themselves are effective in combating the illness, however in order for the full benefit of the medicine to be realised, the patient needs to adhere to the medication regimen. With almost 50% of patients not taking their medications as prescribed (Brown & Bussell, 2011), non-adherence to prescribed medications is an ongoing, public health problem. The Necessity-Concerns Framework postulates that a patient's necessity beliefs (individual understanding of the need for the treatment) and concerns about potential adverse outcomes of medication consumption, influence treatment engagement and adherence (Horne et al., 2013). Horne et al., (2013) found that high adherence to medication taking is correlated to stronger necessity beliefs. This was supported by Bull et al., (2002) who found 56% of depressed patients discontinued anti-depressant medication due to not believing they needed it, leading to interpretation that depressed people have low levels of necessity belief of medication. Other theoretical models support these findings such as the Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB) which state that beliefs of significant others, influence health behaviour such as adherence (Lehane & McCarthy, 2007). Other research supports that patient concerns of previous adverse outcomes of medication taking are strongly related to adherence, such as studies by Horne et al., (2001) and Horne & Weinman (1999).

Much of non-adherence can be associated with multimorbidity and polypharmacy across all age groups, and it is suggested, that 50-80% of all prescription medication users, suffering chronic conditions, are non-adherent (Payne, 2016). Medication non adherence (MNA) is responsible for 48% of all asthmatic deaths, an 80% risk possibility of a diabetic death and approximately 4% increased risk following a myocardial infarction (Varghese et al., 2022), carrying a cost in Europe alone of €125 billion ($205 237 500 billion NZD) each year (Adams & Stolpe, 2016). This figure was measured using an approved, pharmacy

quality assurance measurement - electronic prescribing records linked to pharmacy dispensing databases (Jackson et al., 2014).

There is an abundance of reasons that adult patients do not adhere to medications, some related to the patients themselves e.g. inadequate health literacy, and/or the use of multiple doctors; and physicians may also play a role, when ineffectively communicating information about treatment and adverse effects of the prescribed medication (Brown & Bussell, 2011). There are several common factors of why patients decide not to take their medications – fear; cost; misunderstanding the reason for taking the medicine; polypharmacy; lack of symptoms or change in symptoms; mistrust of pharmaceutical companies and doctors, depression and worry (Mitchell & Selmes, 2007). This research found that there was significant non-adherence to medication routines for chronic conditions, and one main reason highlighted by participants, was the expiration of medicines and the inability to replenish, whether it be an access, cost or other barrier. A patient's non adherence may not simply be about forgetting a dose or refilling a prescription with several congruent reasons affecting the patient's decision to non-adhere; paradoxically there are simple solutions to help patients overcome these barriers and engage more in their treatment (Easthall, 2019). Research shows, that cost can be influence MNA, but also, misunderstandings, taking too many medications and fear of dependency on a medicine; however the biggest reason why patients deliberately choose not to take their medicines, was found to be fear. Patients may be fearful of adverse side effects, or having previously experienced a side effect with similar drugs, or adverse effects that a third party has experienced. Fear can also be a psychological barrier if a patient sees the prescribed medicines as confirming a diagnosis they are apprehensive to accept. There is also convincing evidence that patient-practitioner relationships are significant drivers in non-adherence, as are some policies, such as co-payments which reduce adherence (Elliott, 2009).

Adherence for both young and older populations, is often the responsibility of a caregiver together with their medication interactions, which makes it important that all medication information, is clear to both the patient and the caregiver. Children are also generally dependent on parents or carers for their medicines, and the willingness and ability to administer, as well as the setting, determines the acceptability of the medicine and health outcomes from the treatment. For example, children at school, is a good example where distraction and recalcitrance is strong and factors for non-acceptance of medication (Liu et al., 2014).

MNA is a global problem with related costs reported to be $528.4 billion annually, in the USA alone (Chisholm-Burns & Spivey, 2012). It is one of the major obstacles to effective healthcare (Cutler et al., 2018), increasing the possibility of serious health risks for individuals. The cost impact of MNA on healthcare systems, pharmaceutical companies and the patient themselves, is substantial (Jansen et al., 2021), and extremely common, with strong evidence to support that approximately half of all medicine non adherence is intentional (Lehane & McCarthy, 2007). An extensive body of research suggests that, while patient characteristics may contribute to this behaviour, key influences are linked to beliefs and experiences of an illness and its medicines (Allemann et al., 2017). A great exemplar is Māori women, presenting to physicians with illnesses by proxy, to obtain medicines for their male partners, who are reluctant to engage directly, with the medical profession (Hodgetts et al., 2011). Interestingly, the highest affirmative response and a prominent factor for MNA, found in studies, was, '*I felt better before the medicine was completed*' (Okuboyejo, 2014). Discourse around MNA reported that although some non-adherence was due to cost, 28.2% was not (Wilson et al., 2007). Interestingly, MNA increased linearly with polypharmacy. In another cross-sectional survey, a communication gap was found between the doctor and

senior patients involving prescription medication, from cost factors to compliance measures, with polypharmacy adding to the challenge of understanding for the elderly (Hughes, 2004).

Patient compliance in taking prescribed medicines is a formidable challenge for physicians (Strand, 1994), yet clinicians have ongoing, daily opportunities to interact and effectively communicate with patients on ways to improve their medication compliance. There is sufficient evidence showing that patient education significantly improves compliance with medication across a broad range of disease severities and conditions (Gold & McClung, 2006), and doctors should focus on this available resource. To assist in improving medication compliance, physicians need to give clear, logical, concise instructions when prescribing medication, using familiar lay language, as well as considering a patient's daily routine; and encourage patient participation through self-monitoring. All of these methods have been shown to be proven strategies for improvement in MNA. Policymakers also assume that patients will adhere to their prescribed medication routines, instead of supporting them to do so, which is necessary, if they wish to ensure sustained behavioural change towards compliance. It has been suggested that working together will improve this critical, concerning part of health behaviour, and could achieve significant gains for health systems, patients, physicians, researchers and policy makers (Elliott, 2009).

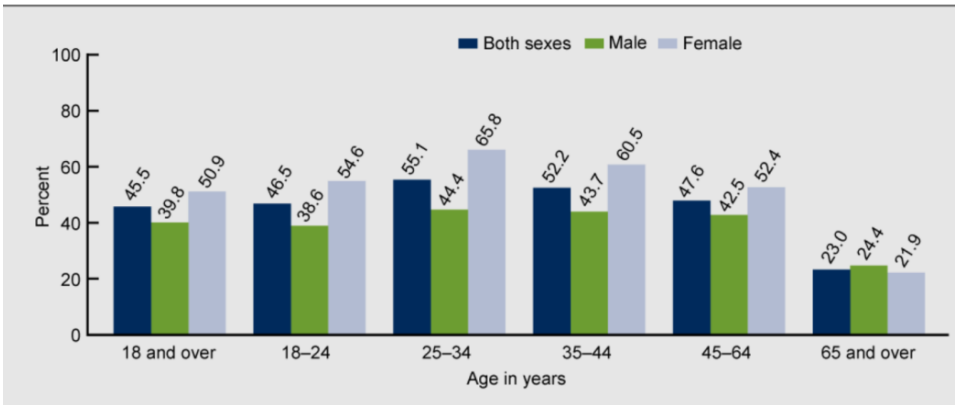
Internet – consumers 'doctor'

Use of the internet for health information is increasingly popular (Diaz et al., 2002), with more and more patients resorting to 'Dr Google' as their first point of medical diagnosis. In a recent survey, 53.5% of participants stated they had obtained medical information on the internet, with 1-in-1000 of these participants, being both educated and in the higher income bracket contradicting popular belief of the opposite (Benigeri & Pluye, 2003). In another study, 60% of participants felt that health related information from the internet was the same if not better than what they would get from a doctor (Levy & Strombeck, 2002). Internet use

to diagnose or detect health related conditions has increased exponentially since the onset of the Covid-19 pandemic, with more searches on prediction and forecasting of epidemics and disease (Bach & Wenz, 2020), with the Pew Research Centre, finding that in 2021, between 67.5% and 81.5% of American adults had used the internet to search for health related information, within a 30 day period.

There are definitive pros and cons to this web-based 'doctoring'- a significant problem being that technology has promoted ease of access to health and medical information on the web, increasing the possibility of an individual accessing factually incorrect or unreliable health information (Battineni et al., 2020), and in danger of assuming an incorrect diagnosis based on internet findings (Saleh, 2022). Recent studies have established that 85% of internet users, aged 18-49, looking for health information on the internet, are women and only 22% of the 65+ age group are interested in medically related topics on the internet (see Figure 6). However, health information seeking for this 65+ group, is increasing as more older people are becoming more familiar with using online resources, increasing their internet activity from 14% in 2000 – 67% in 2016 (Turner et al., 2018). Interestingly, patients with chronic disabilities or diseases are the most active users, as are those who are highly educated (Cohen & Adams, 2011).

Figure 6: ***Percentage of >18 years who searched health information on the internet***



Note: From Online search, Pew Research Center, p2.

Lebanova et al., (2014), found a comprehensible need for monitoring of medicines information available online to prevent patients accessing misinformation that could lead to medication errors. Medsafe NZ, state, "*People should be aware that the organisation behind a convincing looking website may be more interested in making money at their expense than providing a quality healthcare product*'. Medicines purchased online present a risk to consumers because their quality, safety and effectiveness cannot be guaranteed and they may not be appropriate for the intended recipient. However, the internet can be a good thing. It can provide an unlimited amount of information, and provide opportunities for people to search for and access valuable (sometimes useless) information in a convenient, individually tailored way (Korp, 2006). People can communicate with others on important matters of health and wellbeing and the internet which can be empowering (Amichai-Hamburger et al., 2008), by giving the person control and power. Experiences and knowledge of shared experiences between users, also allows the person to feel recognised and emotionally supported (Korp, 2006). With the amount of new medical information physicians have to deal with, the internet is increasingly becoming a resource for medical professionals as well as the lay public; however due to the current amount of misleading information available, it devalues the internet's potential for the physician, due to the time it takes to sort the 'good from the bad' information (Akatsu & Kuffner, 1998).

Although the web provides the potential for individuals to challenge professional interests, there is a strong effort to replace the power back into the hands of experts, by attempting to control sources of health information on the web, through evaluation and quality grading (Moreno et al., 2010). An improvement in the quality of health related websites, would benefit patients, health care professionals, web developers and website owners (Akatsu & Kuffner, 1998). Interoperability in healthcare, can provide information when and where it is needed, it can open the door for faster, more sound decision-making,

reduce waste by non-repetition and improve safety as it results in fewer errors (Benson & Grieve, 2021). This relies on good communication and teamwork and is crucial in health care, as it allows different record systems and software applications to communicate, exchange data and use the exchanged information (Diallo et al., 2011). The aim of successful interoperability is the improvement of patient outcomes and to control expenditure in healthcare (Olaronke et al., 2013). Negative results of healthcare information on the internet, is that it widens the gap in SES status and limits the value of available health promotion strategies that focus on health equity, with many sites trying to legitimise information by authoritative referencing of so called 'experts' (Korp, 2006). Despite the possibility of error, a majority of internet users still prefer to use the web as their first point of information for symptom checking or diagnosis, often presenting this self-found data to their healthcare provider at a later stage (Mota et al., 2018). There is no doubt this trend is not going to change, if anything it will increase and it is extremely important, that the checks and balances are in place to ensure reliability of information to the consumer. Susannah Fox, a former Chief Technology Officer of the U.S. Department of Health and Human Services states, *'The Internet Does Not Replace Health Professionals*', something confirmed by a recent survey finding that 80% of US patients still prefer in room consults to telehealth or web based consulting.

Consumer practices

In this section I discuss in more depth some of the research about the understandings of lay peoples about medications. There is limited qualitative research exploring the meanings medications have to people(, both prescription and OTC medications) and how people integrate medications into their everyday lives. There is a lot of research on perceived risk of medications for patients and lay people.

Social life of medications

Medicines exist in particular social realities; they have bio-chemical properties but are also bestowed with meaning by various cultural understandings. From the time they are gathered (traditional) or produced (western) until they are used by a patient, medicines socially transact. Medications are not solely chemical components (van der Geest & Hardon, 2006), they are things, with symbolic and cultural meaning, and are the most personal of material objects, which are swallowed, inserted into bodies, rubbed on by concerned parents, and used to express care and intimacy. Their substances have been attributed with the power to transform bodies and expected to do something for diseases, (vaccines – prevention; vitamins – strengthen the body), and they are the primary means on which most medical traditions work on illness (Whyte et al., 2002). Understanding medicine usage, goes beyond the chemical compound and chemistry of the medications and incorporates the situations in which the medicines are perceived and used.

Through social experiences and cultural contexts, medications take on meaning (Horne et al., 2004). Some of the oldest documents of ancient people, mention medicines; such as the clay tablets of Sumeria (2100BC), considered to be the world's oldest recorded list of medical prescriptions (Pouyan, 2016). Van der Geest proposes that material things move through various settings, and as they move, either individually or as a commodity for exchange, they are given a value. Pharmaceuticals have biographies and careers; production, marketing, prescription, distribution, death (consumption) and life after death in efficacy, in the treatment of illnesses and conditions (van der Geest et al., 1996). These social lives of medicines are lived between and with people, in relation to problems and contexts, moving away from professional control and made available and accessible to those who can pay for it. They start when a doctor writes a prescription and develop a social life as they move through different actors: consumers, industrialists, pharmacists and policymakers (Whyte et

al., 2002). As well as social lives, medications have social uses and effects (Van der geest et al., 2003), as in, social efficacy. Medication social efficacy is about what taking medication does for the social relationships of a patient. Is getting rid of symptoms their only intention or do symptoms have social implications which form part of the problem? People and medicine interactions are diverse, and the meaning behind offering and receiving medication can differ from person to person. For example, to reject biomedicine and consider it 'counterfeit' whilst adopting the therapeutic properties of flowers, sends a culturally political statement; others 'buy time' with medicines, to prevent being off work (Vuckovic, 1999); and physicians may write a prescription to end a consultation, or to please a patient (Whyte et al., 2002).

While medicine is at the disposal of people, people are also disposed by medicines to understand and deal with their problems in a certain way (Van der Geest 1994). The growing availability of all types of medications, has extensive social effects, creating a need for medicine and increasing the wealth of those who supply them. In a sense 'legal drug dealing', such as the social relations between a drug seller/supplier (pharmacist) and physicians, that encourage people to define and manage problems medicinally (Whyte et al., 2002). The social act of medicine taking is equally a medical one, eliciting and risking qualities such as trust, respect, and concern, because when a patient consumes medicine, they indirectly reveal a part of their social identity whether that is, conventional, traditional or enlightened (Van der geest et al., 2003).

Risk

According to the WHO patient safety is 'fundamental to delivering quality essential health services' and for many, taking medication is a regular part of the daily routine and although it is evident that medicines can help a person feel better and assist in improving health, it is salient that people realise that both prescription and OTC medicines have risks as

well as benefits. Medication risks are the possibilities of unwanted, adverse effects happening with medication use; these effects could be minor (upset stomach) or more serious such as organ damage. The FDA recommends that a patient or individual should consider both benefit and risk of medicine and not take medicines whose risk is higher than the benefit.

The illusion that using prescription medications is safe simply because the medical establishment produces, regulates and prescribes it, needs to be addressed, because medicines can be injurious as well as healing (Kim & Parish, 2017). There is a need for clarity, that the chemical components used to produce pharmaceutical stimulants, if used incorrectly, are as potentially dangerous and addictive as an uncontrolled substance available on the street (Desantis & Hane, 2010). Kim & Parish (2017) found in their study, that when interpreting medication guidelines on some medications, the general public overestimate the possibility of adverse effects from medicine. They also argue that the risk of people suffering harm from their medicines increases with the number of medicines they take, and the amount of medicine a person takes, generally increases with age, as seen in older people being at higher risk of adverse effects due to polypharmacy. Lay understandings indicate that many medications are considered risky and use is based on safety (Webster et al., 2009). To minimise risk, certain sectors of the population are often advised against taking certain medications, such as small children or people with severe conditions. There is also the risk factor of OTC medications and the perception that if they are not on prescription then the risk is lower. Very few pharmacists will take the time to advise on how to adhere and comply to a medicine if it is OTC, even though OTC medicines carry similar chemical components and risks, yet when dispensing a prescription drug, the pharmacist would normally instruct a patient on the explicit use of the medicines. It has also been found that some medicines are highly scheduled in certain countries, and available only on prescription, indicating high risk,

and the same medication in another country is available OTC, with public perception of low or no risk. An example of this is Ventolin in NZ is dispensed on a prescription, in South Africa it is sold at the local pharmacy, without prescription.

Worldwide, medication errors in healthcare systems, are a leading cause of injury, carrying a substantial cost (WHO, 2019) with several types of risk factors for medicines use, such as a harmful interaction between the medicine and food, drink, supplement or another drug; possibility of the medicine making the condition worse or not working as intended. It is commonly known that people take risks all the time, such as driving or flying, but these are calculated risks, thought through by the individual; that the benefit (travel faster), outweighs the risk. The same should be true before the use of any medicine, whether prescription, OTC or even traditional or natural medicines. Once the risks of the medication have been considered, other means to minimise risk and obtain full benefit should be applied, such as make sure the prescriber or dispenser is aware of multimorbidity; polypharmacy or any allergies, particularly if the patient uses multiple doctors. Physicians need to be informed of all barriers to successful medication outcomes, even such things as aversion to swallowing capsules, or size of capsules, dislike of a specific flavour or colour.

Recognition and awareness of medicines with added sugar formations (including fructose and glucose which react differently in the body), assists in avoiding oral adverse events or other drug associated effects of sugary medications, usually liquid formulations. Research shows, that 50% of the most commonly used liquid syrups, contain high amounts of sugar, or 4g (1tsp) per dose, which feeds bacteria (Donaldson et al., 2015). The daily recommended amount of added sugar is 9 teaspoons for men, and 6 teaspoons for women and children aged 2-18 years. Considering most prescription liquid medicines are not single doses, with a usual routine being three times per day, a daily course accounts for 50% of the recommended daily intake of sugar. Interestingly, studies have failed to confirm the relation

between sugar and ADHD, however in a study of sugar-sweetened beverages (SSBs) and ADHD by Yu Chu, et al., (2016), there was a confirmed association between dose-response SSBs and ADHD. Other adverse effects of sugar laden medications are hypertension, diabetes, inflammation etc.

The nature of health promotion is presented to the public as preventative through self-managing risk factors such as exercise, diet and medication adherence and compliance (Laaser & Kovacic, 2007). The Ministry of Health (MOH) NZ, express on their website – "*Physical activity can help people live longer, healthier lives*". Health promotion can also be ambiguous or unclear when warning the public of the dangers of medication usage. For example, "*don'*t *take with alcohol*', may be interpretted to mean that it is okay to drink alcohol before taking the medicine or continue to do so afterwards, but '*don't use alcohol'* as a means to take the medication. The same for '*do not drive*' after taking medication' – immediately after or not during the entire course of the medication? And drive what? A car, motorbike, tractor, forklift? These warning messages are important as they indicate risks of certain medications, and getting them 'wrong' could be a risk factor to safety. These are some of the views which contribute to how people think about expiry dates of medicines. The skewed lens of risk and safety was evident in this research, showing the heightened willingness to ignore possible risk and safety, from the use of expired medications, as a result of no evident and clear guidelines for usage or disposal of expired medicines, at any point in the social life of the medication.

It is theorised that some social cognition models such as the Health Belief Model (HBM), suggests that patients evaluate the risk versus benefit of medication taking. It is hypothesised that patients whose necessity belief in the medication outweighs their concerns of potential adverse outcomes, have greater adherence levels. Patients are often willing to take the risk of adverse effects, medication sharing and using old, expired medicines;

however it was shown that this risk rarely extends outside of the personal sphere of the patient. Many people feel that most expired medicines are not dangerous and carry no physical risk, yet asking them to apply the same psychology and principle to their children or elderly parents, resulted in a categoric refusal to take the risk and a polar opposite view of 'danger' when applied to others.

Individual responsibility for health (healthism)

Public health can appear to be a world of 'don'ts'; '*Don't smoke that*'. '*Don't eat that*'. '*Don't touch that*'. '*Don't do that*'. Promoting health at the population levels starts with encouraging healthy behaviour at the individual level. The public health sector feels they have to warn against harmful behaviours of people, to 'assist' in the individual making the choices they *should* make in order to preserve good health for both the individual and others around them (Finch et al., 2020). Do health problems exist because people do not know smoking is bad for their health, or obesity comes with other health complications?; Do people simply not know what choices they *should* make?, or are societal, economic and environmental impacts making the 'healthiest' choices less feasible or even possible? Many factors could affect an individual's choices other than healthy or not healthy, such as financial issues, limited access to health resources or even structural inequalities – all of which limit autonomy over health decisions (Coggon & Miola, 2011). A patient's age appears to affect coping mechanisms of illness in the individual as well as influence how the person expresses illness, something not always considered by the clinical sector. This same sector is not as patient centric as some may wish and rarely considers the illness or the solution primarily from the individual's perspective.

The identification of healthism in the early 2000's, situated the health and disease problem and solutions at the feet of the individual, ranking a personal pursuit of health above anything else (Crawford, 1980), to the extent that healthism shapes popular beliefs (Misra &

Kaster, 2012). It is also a well-recognized socio-cultural phenomenon in western and westernised middle classes, frequently characterized by high health awareness, the strong urge for information seeking and distrust of doctors and scientists; people who often favour CAM medicine and a tendency to explain disease in terms of 'invisible' agents and pernicious science (Crawford, 1980). Healthism does not consider, in fact ignores, the impact of things like poverty, war, abuse and issues such as traffic pollution, clean water etc and instead judges people's worth according to their health (Crawford, 1980). There may also be a trusting faith in the benefits of certain substances and an unshakeable aversion to others, '*nice, gentle nature*' vs '*nasty, artificial science*', which may result in actual health risks, as seen in the death of a child with diabetes, when a herbalist (later sentenced to a prison term of three years), replaced insulin with a 'natural' therapy (Greenhalgh & Wessely, 2004). Greenhouse and Wessely (2004) looked at real case, patient themes, using a 'critical fiction' technique, to fictionalise actual extracts into new stories. The case studies illustrated a number of behavioural characteristics that tend to cluster in a particular class of health-aware middle class individuals, such as they are typically young or middle-aged, who are educated and have a semi-professional background. This class of individuals generally are users of food supplements and CAM, and health promoted tonics, who seek 'natural' and 'holistic' qualities with enormous concern for 'unnatural' substances (vaccines, chemicals). An interesting common factor is the fear of small insidious threats (germism) and a heightened fear of additives, associating science and medicine with danger rather than safety (Wessely & Greenhalgh, 2004).

Healthism itself, is a specific way of viewing health problems, a form of medicalisation as it still retains certain medical notions (Crawford, 1980), and messages can pertain to things such as, what we should or should not eat; how weight is a correlation of an individual's health status or how a particular diet will improve a medical condition (Hui,

2022). Households are active producers of medicine practices outside of the conventional therapeutic practice, where the development of 'expertise' in wellbeing is from experimental research and consulting with numerous advisors, using health advice gained to produce their own medication practices. Personal practices for medication usually develop from concerns over the conventional practices and advice such as to dispose of recently expired medication. In a sense they construct their own practices by deconstructing scientific 'fact' (Latour & Woolgar, 1986). Households do not simply do what the doctor tells them, but actively participate in decisions of use and risk. Healthism, is also associated with a negative professional-patient relationship which is a continual stress to health professionals as it has the potential to distort healthcare provision (Wessely & Greenhalgh, 2004). Being focussed on food labels, or judging someone on their health behaviours are all healthism examples (Crawford, 1980), but focusing too much on one's own and others health, can have serious consequences. Healthism has even been found in healthcare settings, where some healthcare providers view patients suffering obesity, as lazy. It is also subtle and can be found in health promotion campaigns and everyday conversations, such as '*I can't eat that, I'm being good today'*; '*I'm just worried about your health*'. These sound harmless, but they reinforce the idea that there is a moral obligation to be healthy, or a particular version of healthy and ironic in that healthism is seen as an individual matter, yet it has not stopped followers of healthism from confronting others.

However, although healthism generally focused on diet and healthy choices of the individual, does overflow into medicine and has a sociological connection, with its effort to gain control over a part of the human experience. Crawford (1980) states that healthism sees individual attitudes such as emotions or behaviour as needing 'attention' and not complex like the etiology of illness. The person is determined to resist institutional and environmental constraints, such as doctors and medications, seeing medicine as a clinical science, which

locates disease in the individual body (Wessely & Greenhalgh, 2004). Further, holistic health and self-care followers reject and are critical of these medical conceptions, with self-care grounding much of its philosophy in evaluating and criticising pan-therapeutic culture (Crawford, 1980), attempting to reduce dependency on health professionals, and increase medical self-competence. Much of the enthusiasm for holistic health can be put down to an alienating experience of a medical encounter and an industry that fails to provide satisfactory explanations for such questions as '*why now?*". However, Crawford (2019) claims that healthism is also disabling, as human capacity cannot be advanced only in the subjective sphere. The dissimilitude of physicians however, focuses firstly on the illness that brought the patient in with the priority of treating the disease over prevention of a potential future illness (Rheinberger et al., 2016). It is accepted, that prevention cannot stop all illnesses, just as the medical side cannot treat all illnesses. Ideally, it is thought, the success of global health is dependent on the unity of these two sectors.

Role of media and health professionals

Public demand for health and nutritional information has grown exponentially in the last few years, with people more concerned for their health. However this increased availability of scientific information has not necessarily increased public knowledge (Sharma, 2017). Media (print; television; internet; radio) play a primary role in the lives of people with significantly more people accessing information which is not directly experienced. For people to make good health choices, it is necessary for them to know and understand the information they are receiving (Giustini et al., 2018). There is clear need for 'trust' by the public, that the information received is from a credible source and written in a way that the general population will understand (Arafat et al., 2020). Communicating balanced scientific information to the public, is a challenge, as people are not scientists and already possess their own preconceived ideas. They want to know what is healthy or unhealthy in a way that is

easy to fulfil. A further challenge is a public that expects things to be put as simply as possible by the media, and science that consistently tries to avoid simplification and absolutes (Meriwani, 2022).

It is often seen that policymakers and the health community do not recognise the power of the web, media outlets or organisations in public health (Iglehart, 1994). Interestingly, the same media organisations do not see themselves as being a contributing factor to the public health system, yet they have a responsibility to report accurate, factual and important health and science care information (Schwitzer et al., 2005). Given that most people do not interact with their doctors on a regular basis, the media is possibly the most significant source of health information for the general public; however the public need to grasp that there is no substitute for personal medical advice.

Antithetically, there are significant benefits to using social media in health care and there are times when the same platforms place health care professionals at risk (Hale, 2021). Public health is often caught in a challenging dilemma of both influencing good health practices through media, while counteracting the same influence that encourages unhealthy choices; for example encouraging hand washing during Covid-19 whilst technical interventions such as thermal scanners dominate the media (Leask et al., 2010). Certainly, the media has considerable influence in what the public should be concerned about and how we should think about them (Leask et al., 2010), particuarly in a crisis, such as the Covid-19 pandemic, where health writers and media can quickly deliver important messages to the public (Schwitzer et al., 2005). Health communicators need to thoroughly understand media and how it works, and that it is more than storytelling and writers should understand their responsibility to the public to deliver contextual health information (Lu et al., 2017). It is also suggested, that to gain public trust and support, media and health writers need to practices openness and be factual about who is funding research and who profits from it, and

better research designs are needed to measure the effectiveness of social technologies (Giustini et al., 2018).

The Pew Research Centre claims that social networking services (SNS), (such as Facebook, You-Tube, Google Earth) (Boulos et al., 2014) have gained immense popularity due to increasing healthism and the adoption of healthier living (Giustini et al., 2018). Kamel Boulous (2007) states that SNS's are collaborative, mediated domains used to encourage strong connections, where new information can be shared. Pew research further shows that frequent use of SNS's is associated with increased public awareness and empowerment, with the amount of health professionals using SNS's increasing tremendously in the past 10 years. Today, apps are also used by medical providers. These apps were specifically developed for targetting healthcare workers (doctors, nurses etc), which are more advanced in relation to medical terminology and functions and not aimed at non-health professionals (Mason, 2012). These sites are used by medical professionals to sometimes assist in the primary care of patients; such as Epocrates (a drug reference site) and one of the most used apps of physicians.

The invention of the stethoscope in 1816 by Rene Laennec fundamentally changed healthcare (Sheth et al., 2017), and the more recent introduction of wearable connected devices, has done the same thing. The quantified self movement first made its appearance in 2007, and represents a global, growing phenomenon, which promotes a new form of 'wisdom', which is evident in their motto of *'self knowledge through numbers´* (Ajana, 2017). The term is now used to describe any form of self-tracking, yet 'self' in quantified self is over-emphasised, as management of health and fitness via tracking devices and apps is not confined to the individual (Yetisen et al., 2018) but rather is now a socialised phenomenon and communal trend (Ajana, 2017). The things people can measure or track is endless, for example, heart rate, sleep or even the number of coughs during a period of time,

but these devices, still have some way to go till therapeutic applications can compare to their health monitoring functions. However, this has not stopped the explosion of an industry, reported by Forbes to be worth $27 billion in 2022. As stated by Ajana (2007), "*You might not always have something to say, but you always have a number to report*".

Nonetheless, patients and clinicians live in a complex world, with social determinants of health, such as education, poverty and SES, impacting the patients' quality of life, over and above what health issue they are suffering and organisational culture (attitudes to privacy, financial incentives etc) impacting the actions of the physician (Olaronke et al., 2013). Patients are the sole purpose for healthcare activity and for this reason, it is felt that health services should focus less on income generation and more on outcomes that matter to people (Benson & Grieve, 2021).

How medication is circulated and used

Rational medicine use requires that a proper diagnosis of an illness or condition precedes prescribing medication, as per standard treatment guidelines (STG's) and involves appropriate diagnosing, prescribing and dispensing, followed by proper consumption and compliance by the patient (Chalker, 2012). This section looks at medicines from the perspective of the manufacturer and the patient, and how their social interactions influence consumer practice.

Expired Drugs

At some point in a person's life, they will either have used or will use prescription medication and or administer it. Medicine has become synonymous with everyday life, from OTC pain killers to prescribed drugs for more serious ailments, and most households keep various forms of medication for their own use. Every country has its own drug regulating body, (including New Zealand which is governed by the Medicines Act of 1981), (Gazette, 2022), requiring pharmaceutical manufacturers, to display, as part of medication labelling,

the expiration date of prescription, OTC and even some herbal medications (Gikonyo et al., 2019). These expiry dates, are often referred to as shelf life (Medsafe, 2016), with some manufacturers even using 'best by' in place of an expiry date (Ponen & Lambie, October, 2020). The concern however is that this inter-changeability use of terminology, does not apply to foodstuffs, yet, it has been found that many people treat medication in the same way they do food, which often results in entirely different outcomes. For example, food has the possibility to develop bacterial growth, and cause severe illness, as was the case in 2012, with a salmonella outbreak caused by contaminated Tahini (Paine et al., 2014), whereas expired medication in most cases will only result in decreased potency of the medicine itself (Cantrell et al., 2013).

Between consumers and pharmacies in retail, public sector or nursing homes, billions of dollars' worth of medicines go unused, due to the expiry date stamped by the manufacturer on medicine. There is enormous concern for significant wastage, and sentiment that it is the extreme and unnecessary wastage of still very effective, and much needed medication (Kamboj et al., 1999). The FDA recommends never taking expired medicines, and although the FDA highlight risk they also determine for most medications, that this risk only effects and reduces potency. However, they do acknowledge, that there are possibilities for serious risk dependent on the components and storage of the specific medicine, with expired solid forms of medicine proving more stable than liquids requiring different and stricter storage requirements. Some liquid medicines, if expired, or incorrectly stored, can be dangerous when the components change, however patients cannot always be relied on to be vigilant, observant and knowledgeable of how these changes manifest. For example, a drug that exists in a liquid solution, may be cloudy when it has deteriorated and should be discarded. There is no information on different degrees of 'cloudy', interpretation of which may differ from person to person. It is for this reason, that pharmaceutical watchdogs prefer not to place the

risk and decision making, in the hands of the individual, and seemingly would rather err on the side of caution, as there is no definite way of knowing if a drug is safe unless it is tested. Although loss of potency does not concern many people, it can have major negative health outcomes, particularly if treating a serious infection, for example when using antibiotics (ABs). It has been found that loss of potency in antibiotics can cause antibiotic resistance and in some other medicines, deterioration increases potency and elevated risk.

Most medication, excluding but not limited to such medicines as epinephrine (epi-pen); insulin; and tetracycline, correctly stored, can last well past their expiry date and retain 70-80% of their efficacy, even if opened (Sarla, 2020). Before expiry dates are placed on pharmaceutical products, manufacturers perform stringent testing for stability, in ideal conditions. These resulting dates, indicate the final date on which the medication is either no longer safe or effective, and identify the date, on which the medication should be used by (Ponen & Lambie, 2016, October, 2020). Manufacturers also use expiry dates for legal reasons, to disclose after which date, the manufacturer no longer guarantees potency and/or safe (Gikonyo et al., 2019). Some medications may include specific warnings such as the liquid vaccines of the Covid-19 pandemic, which need to be stored at specific temperatures, ($+2^{o}$ - $+8^{o)}$, (anything outside of this range will result in diminished efficacy and possible destruction of the vaccine). As the vaccine is administered by a clinician, it is claimed, that it is not the responsibility of the patient to understand or comply with expiration dates; but the responsibility of the clinician injecting the vaccine, who needs to consider the risks and keep an eye on the expiry dates of each batch of vaccines, so as to use up the batches in the correct order and in time (Gikonyo et al., 2019) .

Essential medicine is another area of medicines where expiry causes significant concern. A study in a large public hospital in Africa, showed that 80% of the medicines that expired, were on the essential medicines lists (EML) and the main medicines that expired

were vital and included medicines, where non-adherence could be fatal. Available government documentation on how to use, store and dispose of expired medicines, is limited, but less information is available on how to reduce wastage due to medicine expiration. Medsafe, NZ's motivation with expired medications is simply to advise people not to use them, and inform people of their intent to prevent expired medicines entering the community water supplies from improper disposal, whilst attempting to minimise drugs falling into the wrong hands where there is the possibility of causing accidental poisoning. Regrettably, there is very little information to be found on alternative approaches for recycling, returning or redistributing of expired drugs.

For most medication users, whether a drug has expired or not, does not seem to be a concern, with risk not appearing to figure into the decisions of whether to use or not to use the expired drug, unless administering to someone other than themselves.

Solid versus liquid medication

Both prescription and OTC drugs are produced in various forms, doses, colours and shapes, for patient-related reasons, ease of administration and pharmacology, and can be taken orally, applied to the skin, rubbed on to activate ingredients, inhaled, or inserted. These different forms of medications are necessary to accommodate various medicating practices and ensure correct release and intended target of a medicine. Similarities in the acceptability of oral medication, particularly solid forms, such as capsules or tablets (Liu et al., 2014), is shared by both children and older people, and almost all medicine uses the bloodstream to transport the medicinal effect to the intended part of the body. There are five ways in which medicine may enter the bloodstream, each one entering through different avenues in the body; pills and capsules (solids) are absorbed by the stomach lining and small intestine; inhalants (gasses) via the lungs; intravenous (liquid) is direct; suppositories through the large intestine; patches migrate through skin (Kim & De Jesus, 2022). For example, if an

individual has a migraine, and swallows Tramadol, it enters the bloodstream to be transported throughout the body to target pain. The issue with bloodstream transportation of medicine is that as medication passes through the body and bloodstream, there could be interference, interaction with other drugs, be broken down by stomach acid before entering the bloodstream or even trigger serious adverse reactions creating bigger problems. In a sense, working wonders for one condition while dangerously raising the risk of another.

The acceptability of medicine may also be impacted by recognised conditions, either physiological and/or psychological, which may make taking oral medications difficult. Physiological conditions such as dysphagia (difficulty in swallowing) and odynophagia (pain in swallowing) and psychological conditions such as phagophobia (fear of swallowing) and pseudo-dysphagia (fear that the act of swallowing will lead to choking) (McCarty & Chao, 2021), are patient considerations for appropriate forms of medication prescribing which may have an effect on the acceptability of medications, particularly in older adults and children, and subsequently impact the desired therapeutic outcomes. Many parents receive prescription medicines for their children in times of need, and their main priority is to make the child more comfortable, stop the pain and make them better, and they trust that the physician has prescribed the appropriate medicine and the correct dosage. However, rarely do parents read or consider other information such as ingredients or warnings, identified on the medication label, for example, sugar content, which itself could be a severe risk for some people.

The decision by pharmaceutical companies to produce a particular form of medicine, is influenced by the disease it is targeting, the area it is targeting and the user (patient). For example, oral liquid medicines, are generally regarded as the most appropriate form for medicating children and elderly patients. With oral liquid medications, aspiration is a challenge, specifically in elderly patients, suffering from conditions such as dysphagia. It is reported that 51% of patients with this condition, suffer aspiration related health issues

(Barker et al., 2009), paradoxically the same challenges arise with solid medications which need to be swallowed. Where possible these patients would need alternative administrating methods, such as intravenous, injectables or insertions.

There is popular belief that liquid medications are specifically for children, however often, liquid formulations are used to speed up the outcome process, for example, an epi-pen is a liquid injectable, delivering medication quickly, in times of emergency such as anaphylactic shock. Fosomax is another daily medication used in the treatment of osteoporosis, and prescribed in tablet form. There are many patients who suffer severe adverse reactions to the solid form of daily ingestion of Fosomax with the only alternative option being an intravenous drip, dosed annually. Although there are certain conditions for administering this drug, e.g. speed of infusion due to avoid adverse physiological reactions, it is generally tolerated by those unable to take the solid form of the same drug.

Smell, has significant effect on the human olfactory system (Sharma et al., 2019), and one advantage of liquid medications, is that they can be modified in taste, smell and texture to increase acceptability, particularly in children. Medication in liquid form also has definite advantages over a solid form of medicine, such as faster breakdown, almost instant absorption, easier to swallow and faster positive health results and generally, are more suitable to certain areas of doctoring, such as emergency rooms or hospital wards. In addition, capsules in liquid form also have more benefits than powder capsules or solid forms of medication and work faster to achieve desired health results; however the capsule itself still has to be broken down. Despite the tremendous advantages of liquid medication, there are some disadvantages to using this form of medication, such as inconvenience (size), risk of accidental breakage of container; and taste prominence, which could be unpleasant, with liquid formulations having more susceptibility to degradation compared to solid forms (Jamkhande et al., 2019) . Other disadvantages found with liquid medicines is shorter shelf

life and often requiring special storage and disposal conditions, and a high risk of dose volume being incorrectly administered simply due to the possibility of incorrect method of delivery.

The most commonly produced form and prescribed form of medication, are pills, but in order for a pill to work as intended, the drug's molecule must be small enough to be absorbed through the stomach or intestinal lining and be unaffected by stomach acid (Murakami, 2017). And, some drugs cannot work as a pill, such as insulin (a hormone produced by the pancreas). Individuals who need insulin, due to their bodies not producing enough of the hormone, currently inject the drug, as the molecules in insulin are large and extremely sensitive to acid (Giugliano et al., 1978). Paris based Sanofi, a healthcare company, released Afrezza, an insulin inhalant in 2021, which is an option for trypanophobic (fear of needles) people, however, some disadvantages limits its use, such as leaving the body faster than the liquid form, (within three to four hours), and prior to prescribing this drug, patients need to undergo a spirometry test to ensure lung capability which is relatively expensive at USD$230. One significant advantage of liquid medication, as an alternative option, is it has an average absorption rate of 22-30 seconds, compared to the hours it takes pills to be ingested. In cases such as dysphagia sufferers, where intolerance of a particular form of medication is present, liquid solutions, injectables or ointments if available, are preferred choices. It is interesting that six years, has been found to be the average age, at which children could possibly swallow solid medication, however, technology is being developed to aid in medication taking, such as MedCoat, a device used by patients, to coat tablets with a gelatine like substance, or Pill Glide which can be sprayed at the back of the mouth, prior to swallowing (Liu et al., 2014). It is also questioned as why the amount of investment into technology has not considered the reduction in size of the capsule expected to be swallowed, as some common medication capsules and tablets seem to increase in size as

dosage increases, such as the 1000mg 'bullet' of O^3. Further benefits of solid medication is durability, shelf life is substantially longer than liquids and the risk of accidental dosing error is significantly reduced (Yin et al., 2016).

Excess drugs

"The main point about excess in the pharmaceutical industry is how much there is of it." (Marcia Angell, 2004)

The pharmaceutical industry is said to be the third most profitable of all business industries and one of high-risk. Novartis, Pfizer and Johnson and Johnson, the top three pharmaceutical companies in 2021, earned a combined USD$67 billion dollars, expected to reach USD$1.5 trillion, as an industry, by 2023. Not surprisingly, it is deemed to be the least trusted business industry in the world and one most perceived to epitomise corporate greed (Cvetkovska, 2021). Whilst it is asked if big Pharma is in it just for the huge profit or invest the majority of its resources into researching, developing and manufacturing drugs that will benefit humanity and protect them from disease, consideration has to be given to the cost of developing a new drug (around USD$2.6 million), with currently over 7000 drugs in development globally. In contrast, approximately 17%-20% of global pharmaceutical revenue is spent on research and development (R&D) and in perspective and comparison, Apple, a company known for innovation, spent only 3% of its income on R&D (Ljubica, 2021).

Although pharmaceutical production is a profitable market, with the constant development and approval of new drugs and the notable competitiveness of the industry, it is thought that there are still too many drugs being produced, sold and dispensed. Medicalisation is often considered to be contributing to this problem suggesting that the drug industry is in effect, creating drugs for nonmedical problems (Coveney et al., 2019), contributing to 'pharmaceuticalisation' (e.g., Williams et al., 2011). Pharmaceuticalisation

describes the “transformation of human conditions into targets for pharmaceutical intervention” as evidenced by new drugs for conditions such as menopause. Drug companies were then accused of selling sickness to increase sales (Williams & Calnan, 2013). Major concern is that the main output of big drug companies, is not the first-class medicines but the ‘me-too’ drugs, minor variations of extremely profitable medications, already on the market and thought by some, to be gimmicks used to extend monopoly rights on an older megahit brands, as was the case with the antacid, Nexium, AstraZeneca’s almost identical replacement for Prilosec when the rights expired (Angell, 2004). Spikevax, a Covid-19 vaccine produced by Moderna, was approved one week after Pfizer’s Comirnaty vaccine. Both are mRNA vaccines and both behave similarly with respect to safety and efficacy, demonstrating that multiple pharmaceutical companies are often working on the same program, at the same time. These type of drugs have been hugely successful for pharmaceutical companies (Aronson & Green, 2020).

Excess medications are also highly influenced by ineffective policy, hoarding, over prescribing and over dispensing practices and pharmaceutical over production of duplicate and similar medicines. Medication patent expirations alone, account for about $36 billion in prescription drug revenue globally. The past few years has seen the pattern of medicine purchasing change, further contributing to the increase in purchasing volumes and excessive home accumulation of drugs. This demonstrates the association between excess medicine, wastage and home storage, linked to inappropriate prescribing practices and inadequate adherence and compliance by patients (Jafarzadeh et al., 2020).

According to the World Health Organization (WHO) more than 50% of medicines dispensed or sold, are inappropriately prescribed, adding to unnecessary storage and wastage. It has been found that 50% of patients do not take their medication correctly and many patients keep unwanted or expired medicines for later use, often resulting in indefinite storage

or incorrect disposal, and hospital policy accounts for a large portion of medication wastage (Wieczorkiewicz et al., 2013). Excess medication in hospitals, is responsible for 60% of all post-operative prescribing, with half the patients not utilising a fraction of the prescribed drugs (Sabatino et al., 2018). Many clinicians and healthcare professionals working in long term facilities such as nursing homes and frail care facilities, are equally concerned about the amount of medication wastage they incur, but are restricted by in-house and governmental regulations. Kamboj et al., (1999) found that excess medications in such establishments result from patients not being able to complete the prescribed medication due to such things as allergic reactions to the medicine or they go home before completing the course of medicines. They also found, that in nursing homes, staff are not permitted to pass on medication, regardless if another patient has exactly the same prescription and condition. The same study found that much of medication excess and wastage is caused by the under utilisation of perfectly safe and usable medicines, already paid for by either the state, health insurance or the patient themselves, a situation which cost the USA $2billion per annum from long term facilities alone. End of life (EOL) medication is another contributor to medication wastage and a substantial financial loss for pharmacies, not only in medication costs but the added costs of disposal, (Godeliver Anatory Kagashe, 2014), which in most countries, is not subsidised and usually managed by a private organisation. The fixed shelf life of medicines (expiration date) dictates when medicines have to be disposed of; with one in four people struggling to afford needed medicines, and 10 million prescriptions ($700 million annually), which could be salvaged, it makes no sense that there is insufficient policy and strategies to drastically reduce medication excess and wastage.

Storage (how and why)

The stability or degradation of medicinal products is highly influenced, both chemically and physically, by temperature, which may result in bacterial growth,

precipitation or splitting. Understandably, extremely high or low humidity is equally problematic for drugs which may cause microbe growth, particularly in warmer conditions (>30°C with 75% humidity). If stored correctly however, many drugs can last well past wexpiry and shelf life, although reduced efficacy and/or potency may occur. To ensure safety and quality, as well as efficacy of medications and medicinal products, appropriate storage is absolute (Housheh, 2017). Industry guidelines indicate that medicines should be stored out of the reach of children to prevent accidental poisonings or adverse effects, in the original packaging and at various specific temperatures (dependent on the medication, usually between 15°C and 30°C) (Medsafe, 2014).

Unfortunately, little is known about how people store medicines in their homes and elsewhere, why these locations are chosen, or whether the conditions are even suitable for medicines storage (Hewson et al., 2013). Available research has identified some common locations for storing medicines, ranging from around the home, hospitals, cars, ambulances, to helicopters and even handbags, most of which do not meet the temperature guidelines, particularly in warm conditions (Hewson et al., 2013). Hewson and colleagues (2013) in a survey of 104 households found the kitchen to be the most commonly used location for storing medication; however, very few households considered the fridge as an ideal location for storage, or they assumed it would be too cold. Of the households 18 stored their medication in cars, backpacks, garages, handbags and under the mattress. Most households used multiple storage areas with the average being three different locations in the same home. Reasons for these decisions given was mostly convenience, emergencies, and safety. It was argued that the location is also changed to the bedroom when a medication needs to be taken in mornings or evenings.

In a study of extensive literature reviews of medication storage in Pakistan, Aziz et al., (2018), had similar findings, determining that a huge portion of the US $25 million spent

on medicine procurement, was wasted due to incorrect storage. The same study also found, that most of the medication wastage resulted from climate temperature, although a large contributor was pharmacy outlets storage facilities (Ali et al., 2016). A similar study of 139 households comprising 68 liquid and 108 solid forms of medicines, investigated the 'where' and 'why' of medication storage (Kiyingi & Lauwo, 1993). Liquid formulations were found to be the most inappropriately placed and incorrectly stored of the two drug forms. Of the 68 liquid medications, 15 were found to be less than two weeks old and in use, and 25 of the 68 medicines were more than two weeks old, not in current use, and with no intention to use in the future. The solid medications, in a range of 0-93 weeks, were found to be kept on average for a period of 10 weeks. All of the solid medication was found to be suitably stored as far as temperature but some were unsuitably placed on open shelves or actively used tables. Antibiotics were in 27 of the 108 surveyed households but were large quantities of unused AB's indicating poor compliance. Participants suggested that the ABs were intended for future use, indicating inappropriate self-medication (Kiyingi & Lauwo, 1993). This research also found most households made use of medicine cabinets or spaces in unused cupboards to store their medicines as well as fridges being the location of choice for any liquid medications. Only one out of the 20 interviewed participants was concerned about safety of children in regards to location of medicines (Makki et al., 2019).

It is evident that there is a requirement for better public education and motivation on rational drug use to ensure benefits to health and economy, with incorrect storage and wastage raises healthcare costs and endangers patients. It is not certain why people keep unused drugs, as it has been found that even those intending to use them in the future, rarely do so. The most considered explanation was that most individuals feel it inappropriate to dispose of unused medications when so many people in the world do not have access to prescription medication. It was also communicated that there is little information on

recycling or redistribution programs available to lay people, and keeping these drugs is morally more acceptable.

Disposal (how and why)

Reduction of medication waste at each step of a drugs lifecycle, implementing take-back options, collection at approved sites and modern technology to treat wastewater are highly recommended to reduce effects of unwanted pharmaceuticals on human health and environment. It is interesting, that unwanted or unused medications are only considered properly disposed of, if these methods meet the health guidelines for disposal in that country. However, although many countries offer facilities where medications can be returned for disposal and have easily accessible, public information as to where to return medications or correctly dispose of medications. NZ surprisingly, does not have any formal rules governing the return of unwanted medicines (Makki et al., 2019), but it does attempt to encourage the public to return these medications to community pharmacies. However where to find this information or finding a pharmacy that accepts unused/unwanted medications is not easy. Disposal of unused and or expired medications in NZ is also not free and disposal is operated by private companies, a reason many pharmacies are averse to accepting medication returns. The USA in comparison, has formulated a framework to deal with their disposal of medicines and since 1998, Australian pharmacies, utilise a program called NatRUM, a free program for medication disposal.

With little available and easily accessible information for the disposal of medications, it is no wonder that the general public resort to improper disposal practices, such as throwing medications into a trash can, down the toilet or sink, or even giving it away, given that they are mostly unaware that these actions are incorrect. In 1976, Law and Chalmers surveyed patients 75 years and over to investigate how this group managed their medicines, including disposal. They found most were uncertain as to how to dispose of unwanted drugs, and 42 of

the 75 patients, used the lavatory for the disposal of unused or unwanted medicines (Law & Chalmers, 1976). It appears not much has changed in almost 50 years, with Widya et al., (2020) showing from their cross-sectional survey of 497 respondents in Indonesia, that 95% of the respondents had unused medicines stored in their homes and 82.1% used environmentally unsafe and/or risky practices for disposal. These unsafe disposal practices were supported by the study of 359 households, 96% of which kept unwanted or unused medications in the home, and 15.5% used pit latrines to dispose of medicines, even though 76% of the people surveyed, admitted awareness that improper disposal practices are detrimental to the environment and human health (Marwa et al., 2021). Kuwait is another country that does not have an official program for medication disposal and both pharmacists and the public dispose of medicines by pouring them down the sink (Makki et al., 2019). In Tanzania, a cross sectional study of 111 non-government hospitals and private medicines outlets found that at the time of the survey, 60.4% of the facilities were storing medicines in need of disposal, the majority of which were ABs (64.1%) and only 10% of these facilities, maintained an unfit medicines register with 41.4% of these facilities pouring unfit medicines down the sink or disposed of them in public garbage cans (Mwita et al., 2019). Shareef et al., (2016) found in a comparable study in Saudi Arabia, that household waste, toilets and sinks were the most commonly used method for disposing of unwanted medicines, even though 61.7% of the participants admitted to a belief that this was an incorrect method of disposal and were aware of medication collection facilities (Al-Shareef et al., 2016). Very few participants were aware or concerned of any environmental impacts of disposal methods that fed into the natural environment, and general knowledge in Saudi Arabia, of medication disposal, is low. In contrast those interviewed indicated eagerness to be educated in the processes for safe and appropriate disposal of unused or unwanted medicines. This unawareness is also seen in the NZ public, despite programs such as the DUMP (Disposal of

Unwanted Medicines Properly) campaign, which encourages patients with expired or unwanted medicines to dispose of them through this initiative. It is a collaborative effort of Auckland pharmacies and the various NZ health boards, offering free and safe collection and disposal of prescription, OTC and any other products considered medicines, as well as needles. However, several surveys have found very few people are aware of this campaign and none of the interviewed participants in the research of this paper, had heard of, or used it, indicating more awareness of such offerings through doctors, pharmacies and marketing media is necessary.

Recycling

Detrimental effects on the environment from incorrect medication disposal practices, as discussed above, together with worldwide medication shortages, calls attention to the potential cost savings and health benefits, of recycling medicines. Barriers to recycling start at the level of the individual, with little information and guidance on which medicines to recycle, how and where to recycle and what happens to recycled medications; and ends with the push for legislation to approve the redistribution of medications, which is currently lacking in the majority of the world's countries.

Viewpoint

In 2017, the WHO reported that each hospital generated between 0.2-0.5kg of wastage every day, of which 3% was medication wastage. In the USA, a survey conducted by Gebramariam et al., (2019), of Pharmaceutical CEO's and pharmacy heads, concluded that there was extreme medicinal wastage in public health facilities and revealed conflicting and contrasting beliefs of wastage increase or decrease, with one respondent claiming: "*Medicine wastage is decreasing due to the advent of Integrated Pharmaceutical Logistic Systems (IPLS) in recent years*", and another respondent in the same survey, claiming "*Medicine wastage is increasing overtime since we are receiving medicines from central/regional*

medical stores based on a 'push' system" (Gebremariam et al., 2019). Fundamentally, the purpose and need for recycling medicines, is to be able to redistribute medications to those who cannot afford them, evident in studies showing almost 8% of adult patients, in the USA are non-adhering to medication practices due to financial costs, something commonly reported in both developed and developing countries worldwide. It is commonly accepted by both the healthcare industry and lay people, that most unused medicines are found to be both effective and usable, but due to legislation, a medicines life cycle ends at consumption or destruction.

There is very little research as to why this mindset continues other than the cost factor of implementing bona fide recycling programs which would culminate in excess and unused medicines being distributed to those in need. NZ itself, has no established program to allow for the recycling or redistributing of unused or unwanted medicines and yet Associate Professor Braund of the University of Otago, Department of Preventive and Social Medicine, questions why NZ cannot legislate and implement programs for the eventual collection and redistribution of operational programs, when she says "*There are two problems: people unable to afford the drugs they need, and large amounts of unused medicine, with an obvious way to solve both at once.*" Derek Richardson, General Manager of Interwaste, a specialist company for the disposal of medication waste agrees with Braund when he states "*in my opinion unused drugs could be redistributed, especially expensive and out of reach drugs*". Kas Govind, a pharmacist in a poor suburb of NZ, (Porirua), claims he has shelves full of uncollected prescription medications, all of which he cannot reuse due to NZ having no fixed policy on disposal of expired, unused or unwanted medicines. He goes on to say that the world is a consumerist market – where it is cheaper to dump than repair. Graham Platt agrees with Govind about the lack of policy but believes such a program would be simple to implement and one which he himself operated in the 1960's by collecting, sorting and

redistributing medications to third world countries. However, Professor Pauline Norris of the School of Pharmacy at the University of Otago questions the success of such programs as she believes that the strict guidelines in NZ of how pharmaceutical drugs should be stored, at certain temperatures, makes it difficult for drugs collected from homes to comply. This paper identifies the gaps in this particular area; however it provides evidence for support and success of such programs, with clear opportunities and processes to overcome these perceived barriers of recycling and redistribution programs.

How and where

Over the past decade the worldwide move to 'recycle' medication has grown substantially and many countries have implemented drug return programs, such as the 2010 US National Prescription Take Back Program (NPTBP) and the Australian NatRUM program, in an attempt to reduce the misuse or abuse of unwanted, unused or expired medications in households. Although successful, (10 years after the setup of the US program, it had collected over 5.5 million kilograms of returned prescription medicines), both of these programs, marketed as recycling initiatives, are programs which purely collect medicines, for the purpose of disposal. However, more recently, the USA, in 2021, with each state legislated independently, 40 states passed legislation to establish prescription drug repository programmes, for the collection and redistribution of unwanted medication. Sadly, only 27 of the 40 states currently have operational programs. Another US redistributive company SIRUM, founded in 2009, in Palo Alto, by Stanford University students, redistributes medicines based on need, and another state run program in Iowa, USA (which has a similar population to NZ, with 3.1 million), helped 71 000 patients by redistributing $17.7 million of medications to those in need (Chaudhary & Murata, 2015). In 2020, NatRUM amended their model and implemented guidelines for the donation of medicines to other countries; however it is bound by strict regulations (e.g., Countries have to specifically request a donation of

medicines and they have to specifically ask for the type of medicines they need). These redistributive initiatives are improving and ensuring public awareness of these programs, together with ease of return, through promotion, in such things as National Take Back day and arranging physical drop boxes in various areas of Washington State, for the drop off of unwanted or unused medicines. Washington State also offers further assistance with an option to return medications through the mail, free of charge. In the UK, there is a growing acceptance and usage of a program called Recycle Now, however at this point in time, they do not recycle medicines, although ironically there marketing strategy is '*to motivate more people, to recycle more of the right things, more often*'.

NZ, in contrast, does not currently recycle or redistribute medications, in fact they are categorical that all unused, unwanted or excess medications must be disposed of; yet offer no incentive to do so. There is limited information on medication disposal options available to the NZ public, and what is available, is hard to find. Pharmac encourages the public to dispose of medications correctly by offering people an option to return medications to retail pharmacies. The problem with this is that not all pharmacies accept returned medication, and most do not want to do so, due to the cost of disposal, which currently, Interwaste, a private specialist company, has the majority market share. Derek Richardson the General Manager of Interwaste, an avid supporter of recycling and redistributing of 'wasted' medications, claims that currently, medications have to be steamed to deactivate ingredients of the medicines, as NZ has no incinerators capable of destroying the drugs; whilst Kas Govind a Pharmacist in Wellington, argues that steaming does not deactivate medication ingredients and only changes the chemical compounds, suggesting an inadequate 'disposal' option. Legislation for the reusing of medications requires urgent review, with NZ throwing over NZD$40 million, of usable, effective and much needed medications, into landfills each year,

because of outdated legislation which does not allow for the recycling or reuse of unwanted medication.

Expectations after recycled

There is limited public awareness of the possibilities of recycling medicines which are end of life (EOL), or end of use (EOU), and limited guidelines, for public information on the process of such initiatives. There is even less understanding of the possibility of these expired, excess or unwanted medications being reused and redistributed, or strategies to reduce waste and ultimately help those in need of these medications. The subject of donating medicines raises strong opinions from healthcare and humanitarian organisations and this paper has shown that these same opinions are evident in the general public. The concerns of official organisations have some merit, as history has evidenced bad practice of attempts to reduce wastage while simultaneously aiming to help other people and countries, such as inappropriate medication containments or dumping of expired medications without due process, which could result in dangerous health outcomes. The 1976 tectonic earthquake in Guatemala (Plafker, 1976), is an example of such adverse outcomes, which resulted in the international donation of 7000 cartons of medications to Guatemala, with good intentions, but without much consideration. This particular donation took six months to sort through, after which only 10% of the medicines were found relevant to the situation's health needs (Spencer et al., 1977). The excessive amount of available counterfeit medicines, worldwide is another barrier in a governments' unwillingness to introduce programs for medication re-use, when there are many documented cases of patients with minor conditions dying as a result of being treated with simulated, suboptimal medicines (Mackey & Liang, 2011). (Robertson et al., 2002) argued that any humanitarian endeavour such as medication supplying must always take human rights, suffering and social context into account. The Sphere project, started in 1997, aimed to promote guidelines to promote quality humanitarian work (Sphere, 2021).

The result of this project some years later, was the Sphere handbook, one of the most internationally recognised sets of common principles and universal minimum standards for humanitarian response (Asher et al., 2008). There will always be those who will say that medication donating breeds dependency, or the end does not justify the means, or those with an 'in the box' outlook, believing that if the capacity of individual health systems was improved, there would be no need for donations outside of that country, but it is evident, that medicine donations are as much a need, as much as any other humanitarian aid.

Presently, after medicines have been recycled, most countries, simply dispose of them, which raises concern for the promotion of recycling, understood as meaning re-use. Further evidence supports that countries with recycle programs, focus is on the recycling of the packaging of the medicines and not the medicines themselves. Research on the expectations of the general public, for medication recycling is limited but what has been found, particularly in this paper, is that the public and many organisations, envisage less wastage, less expense on the state and less environmental impact caused by medication excess. It is also evident, that many people cannot understand the aversion to such programs when recycling is available for most other commodities. As some countries currently have active and successful programs for redistributing medicines, there is a general feeling, that it can be done, but ignored. However, some of the participants in this research, did raise similar concerns as organisations, when they asked the question '*If expired medicine is not appropriate for me, why would it be suitable for someone else?*'. Further raised concerns were the ethics of donating medication, which was less effective, something echoed by Saha and Gapler., (2013) when they state that '*even though there are severe medicine shortages, the impact of subpar medicine on human lives, does not leave other countries free from ethical constraints, particularly when donating to third world countries*'.

Interestingly, IHP UK and the US Aid for Aids (AFA both have logistically, ethically and successful return and redistributive programs, and should be used as flagships for other resistant countries to develop their own programs, echoed in the words of Martin Luther King – "*Every man must decide whether he will walk in the light of creative altruism or in the darkness of destructive selfishness. Faith is taking the first step, even when you don't see the whole staircase*".

Wastage

Medication wastage is a worldwide, well established phenomenon, acknowledged by the general public, healthcare facilities and governmental organisations. The WHO defines medicine wastage as '*unwanted medications which include expired, unused, spilt and contaminated pharmaceutical products, drugs*'. Every year hospitals, clinics, private healthcare concerns and the public throw away billions of dollars of effective and usable medication, while over five billion people globally, cannot afford or get access to appropriate medicines. Reasons given for resistance to reusing, or donating excess or expired medications, are mostly invalid. One of the major reasons given is public 'safety' yet many countries expose the public to medication health risks, as argued by Morena et al., (2020), whose study found Guatemala general stores dispensing ABs without prescription, or trained knowledge. Many countries have programs for collection and disposal, but few have dedicated programs to collect, check and redistribute medicines, to reduce wastage and assist those in need.

Current

Over USD$1.5 trillion dollars is currently spent globally on prescription medicines each year, and millions of dollars lost on wasted medication. It has been established, that most of the medicine, which is stored in homes or disposed of, is re-usable. Bekker et al., (2018) found in their study of 759 returned medications, 298 of them were classed as

preventable waste (39.3%), but legislation dictates that such medication must be disposed of. Drug wastage has implications on healthcare costs, and reduction of available medicines, but despite several campaigns to introduce effective return programs, there is little emphasis on extending these programs to accommodate medicines being reused. Toh and Chew, (2016) found that during their study, many healthcare institutes were in disagreement on medication recycling, with major resistance around patient safety, establishment and processing costs (Toh & Chew, 2016). This hesitancy could be explained by physicians having to consider their prime obligation to improve health against professional dangers to themselves and their institution, by possibly violating regulation, as argued by Iserson (2021) when a diaphoretic, tachycardic patient presented with chest pains at an emergency department (ED). With no percutaneous coronary intervention (PCI) available, the doctor's only option was to use a thrombolytic drug; however the only available stock of the drug had expired two weeks prior, leaving the doctors in need of an immediate decision between their professional duty to maximise care against violation of regulations by using an expired drug. In this case, there was a need to understand myths, regulations and science of drug expiry dates (Iserson, 2021). Such sentiment is supported by Army Colonel George Crawford, a qualified pharmacist when he says, "*nobody tells you in pharmacy school that shelf life is about marketing, turnover and profits, even though the drug manufacturers won't agree*".

Way forward

A patients' quality of life is impacted not only by what is the matter with them and how they are treated, but by social determinants of health in a complex world. Determinants such as poverty, education, where and how they live, and what clinicians do is impacted by the culture of their organizations, including attitudes to safety, privacy, innovation and financial incentives. It is felt that healthcare and health services should focus on the outcomes that matter to patients, and not just on income generation. Kas Govind, a pharmacist in a

poorer suburb of NZ, claims '*There are consumerist ideologies, in a consumerist market where it is cheaper to dump than repair'*, supported by Graham Platt, also a pharmacist who believes a program to provide safe, effective and affordable medicine through the reuse and redistribution of medication, is a simple, feasible and achievable possibility. Professor Braund of UOA, blames Pharmac's 2003 change in dispensing laws for increased medication wastage, that allowed patients to collect three months' supply of certified medicines all at once. She states that paracetamol is a good example of extreme medication wastage, with patient's being dispensed a three month supply. This results in a patient being dispensed eight tablets per day, 720 tablets for the three month period and Braund argues that even the most compliant patient will not utilise 720 tablets. Pharmac themselves acknowledged this in 2015, when they re-introduced restrictions for some drugs and surprisingly, reversed it again in 2020, with the reinstatement of the '*all at once*' policy for pharmacists, attributing this reverse action to Covid-19 (PHARMAC, 2020). Further, in NZ, BPAC found that only 56% of all prescribed medicines were collected and 25% of repeats, with customers reasons being they were no longer needed or wanted (BPACNz, 2021b).

Platt further believes that the absence of a countrywide policy is a major barrier in reusing medicines and Professor Norris of UOA, in contrast, questions whether such a program, regardless of policy would work. International Health Partners (IHP) UK, a charity which strives to improve health outcomes across the world, by improving quality and quantity of donated medical products, solves some of these concerns and issues, by functioning as an intermediary between pharmaceutical companies and humanitarian agencies. In the USA, the FDA, has overcome such barriers, by giving each state responsibility and accountability for redistributive programs and in Christchurch NZ, a charity donates surplus medicines to undeveloped countries. This research also found that many of the participants were aware of pharmacists in the South of Auckland accepting

returned medications which were sent to the islands. Hess et al., (2018) challenges pharmaceutical manufacturers, doctors and policy makers to reduce medication waste and cost, by simply allowing optimisation and sharing of vials, in cancer patients. Vast amounts of much needed medication is wasted due to oncology drugs being dosed by body weight or size and doctors not using vials which match the need of the patient, costing USD$8.5 million dollars annually. Hess (2018), goes on to say that by utilising vial sharing alone, annual costs due to wastage, were reduced to USD$ 7.4 million (Hess et al., 2018). There is absence of research on the actual function of the systems used in the successful programs, however Kongar et al., (2015) feel that to ensure successful redistributive programs, all is needed for EOL pharmaceutical products, is a novel IT infrastructure to expand on current reverse logistics (Kongar et al., 2015). Implementing medical reverse logistics (MRL) would ensure continuum of the life cycle of medicines past their current 'death' by expiry or disposal.

There is evidence and research to support that medicines could be and should be recycled and redistributed in New Zealand. No current information was found regarding what processes the current successful recycling and redistributive programs currently use and there is still disagreement by professionals if these programmes would work in practice. The first step is to find out what lay people understand around expiration dates and expired medications which is the aim of this research.

Chapter 3

Methods

Epistemology and research design

The purpose of this phenomenological study is to investigate the phenomenon associated with patients and the lay public, and their experiences and interactions with medications, how they understand pharmaceutical expiration dates of medicines, and how this influences their decisions of adherence, non adherence, compliance, storage and disposal of medications. It will also determine the participants understanding and viewpoints on the recycling and redistribution of excess and/or expired medications and the implementation of such programmes.

The research study is a phenomenological qualitative design. As defined by Groenewald (2004), "*phenomenology is concerned with the lived experiences of the people involved, or who were involved, with the research issue*" (p. 2). Phenomenology is an approach used to investigate experiences in health research (Pringle et al., 2011) and has proved a methodology popular for qualitative research (Thomas, 2005) due to the ease and specificity of which it can be applied to a first person experience of illness. For this reason, it was a suitable methodology to explain the actions individuals have with medications and expiry dates. This research uses the interpretative phenomenological approach (IPA), which seeks to understand experience associated with phenomena (Van der Walt, 2020). IPA was developed specifically for psychological research, to allow closer proximity to the lived experience of participants, as possible by exploring and understanding how participants make meaning of a lived experience, from their own social and world perspective (Reid et al., 2005). Smith et al (2022) states that IPA has three theoretical underpinnings concerned with examining the experience (phenomenology), interpreting the experience (hermeneutics) and the nature of specific accounts (idiography) (Shinebourne, 2011), briefly discussed in turn:

Phenomenology

Edmund Husserl, the founder of phenomenology, established the significance of examining experiences in their own terms (Manen, 1997). A phenomenological approach provides a more contextual approach through uncovering and interpreting the meanings of 'stories' of participants and research using IPA, must leave behind assumptions and preconceptions they have about the world so as to avoid obscuring the true nature of any experience and use reflection to examine this experience (Greenfield & Jensen, 2010). It also places the individual in the 'role' of a highly valued expert, which encourages participants in IPA research to communicate through their own narratives, in their own words (McConnell-Henry et al., 2011).

Hermeneutics

Hermeneutics is the theory of interpretation (Forster, 2007) and IPA needs an interpretive approach to uncover participants true meaning of their experiences as described by Smith et al., (2009) as ' *there would be nothing to interpret without phenomenology and without hermeneutics, the phenomenon would not be seen'* (p.37). Gadamer describes hermeneutics as ' *a reflection of historical circumstances where we are the result of the effective histories of the very texts and discourses we seek to understand'* (Warnke, 2016).

Idiography

Finally, the of theoretical underpinning of IPA is idiographic, focusing on the analysis and understanding of individual experiences rather than at a group level (Smith, 2010). When seeking participants, consideration should be given to obtaining homogenous samples to ensure the differences found in the individuals are due to their differences, not demographics. It is equally important to adopt small and purposeful samples, to ensure thorough and detailed analysis of each case and the experience of interest is represented (Smith, 2010).

This type of research design, is ideal for use in qualitative psychological research, where it provides knowledge on how the participants understand medications and how they experience medicines in their daily lives, and how these experiences influence decisions to adhere or non adhere to medication routines, recycling and disposal practices. The participants will be asked a series of open ended questions, via either a face-to-face or online-video interview, in order to gain insight into their specific experiences with medications. This narrative phenomenological approach allows participants to relive their experiences and recount them to the researcher, which will provide the foundation for a thematic analysis to describe the quintessence of their experiences.

Research Ethics

Research commenced after Ethics approval was received through Massey University's ethics committee, reference number NOR21/95. I engaged with Massey Code of Ethics and Te Ara Tika guidelines. In practice, the ethics for this research focused on the following; personal information, distress, and informed consent. Although the focus was how individuals interpret medication instructions, some personal and sensitive information may have been revealed, such as what illnesses or conditions the participant may be experiencing or had experienced (for instance depression, or a sexually transmitted disease) or social issues such as reasons for using expired medications. I had prepared my interviews to run from a pre-existing set of questions, which would encourage the participant to discuss their personal interactions, experiences and views toward medications, without pressuring the participants to reveal any more than they wanted to. I did not encounter any area where the participant needed to avoid a question or stop their narrative due to sensitivity. I did however find that many of the participants experienced a cathartic effect when delving deeper into the questions. No monetary reward was offered to the subjects for participation (Appendix C).

After an initial phone call, I personally emailed an information sheet and consent form to each participant. The information sheet clearly explained their privacy would be protected and any information received, would be kept confidential and stored securely, as well as their anonymity protected with the use of codes substituting actual names, in any transcribed or stored data. I also ensured prior to interviews, that due to the diverse culture groups to be interviewed, that I applied cultural sensitivity, for example, with my dress-code, appropriate communication and I also conveyed I was interested, enthusiastic and teachable. After completion of the interview, 15 minutes was spent debriefing the participant, the purpose of the research was reiterated, and I allowed the participant to voice any concerns which may have arisen from participation.

Participants

The participants included 10 cisgender men and 10 cisgender women between 20 and 75 years of age, from the general population of New Zealand. Most of the participants were fluent in English with only one participant having conversational English language ability and 11 of the respondents being college educated. 20 interviews were completed, with participants being drawn from across nine different ethnic groups, with an unexpected equal split of males and females. Seven of the twenty participants were not currently taking any prescription medication. Of the 13 participants who were currently on prescription medicine, all were on daily routines and seven of them were polymedicating.

Sampling Procedures

I chose not to limit participants to any particular demographic (see Table 3), in order to access a wider range of viewpoints on the subject; realising that different illnesses, conditions, ethnic backgrounds, age and socio-economic status (SES), would offer different perspectives. An advertisement (Appendix A) was placed on a private Facebook Page, and distributed through three medical outlets; (Community Doctor; Pharmacy in Silverdale and a

medical centre). I opted not to use any family members or more than one person from any family. 20 participants were recruited; (Auckland 10; Christchurch 5; Wellington 2; Wakaito 2; and Northlands 1). Criteria for inclusion was:

- To be 18 years of age or over
- To use / have used prescription medication
- To be willing to share understanding and experience of medication expiry dates
- To consent to participate

Table 3: ***Demographics of Participants***

Gender	Age	# of Meds	Akl	CC	Well	Ethnicity	Code
Male	75	3	1			S. African	P20115113
Male	58	4		1		Euro	P78114145
Male	54	4	1			British	P34181115
Male	38	0	1			NZE	P11212020
Male	20	3			1	NZE	P12351212215188145
Male	65	2	1			NZE	P45119525
Male	67	2	1			NZE	P83151814231897820
Male	26	1	1			S. African	P212523919
Male	60	2		1		Canadian	P42651320518
Male	37	0	1			M. Eastern	P19215141114118
Female	35	1			1	Tongan	P2133755
Female	40	5	1			S. African	P1120211814518
Female	48	3	1			Tongan	P221514515145
Female	30	1	1			Tuvaluan	P191919201121
Female	32	4		1		Pacifica	P20615147
Female	58	0		1		Asian	P638114
Female	59	1	1			NZE	P318116191514
Female	42	0	1			Asian	P1923114
Female	60	1		1		NZE	P19139121219
Female	25	1	1			S. African	P1526231182019

Data Collection

I collected qualitative data using a single in-depth face-to-face interviewing method, which due to Covid-19 restrictions, at times had to be performed through a business platform such as Teams or Zoom. I allocated a minimum of one hour per interview to ensure enough time for the participant to narrate their experiences at their own pace. Once the participant had made contact via telephone or email, I verbally explained the project and the process it would take. I allowed for any questions from the prospective participant, and if participation was accepted, the consent form and information sheet was emailed to them, together with a request for a suitable time, date and place for the interview. Once this information was received together with a signed consent form, an agreed time for the interview was diarised, and meeting scheduled. For those utilising Teams or Zoom for the interview, an electronic invite created sent to the participants email.

Interview

Most of the Team interviews were conducted in the evenings due to participants' work constraints and privacy, with only two of the interviews being conducted face-to-face. at a mutually agreed private venue. Five minutes before commencing the interview, I explained to the participant that the session would be recorded, and reassured the participant, that all information would be kept confidential and anonymous. I sought their permission and agreement before continuing. None of the participants disagreed to this.

I used an in-depth method of interviewing, facilitated by a questionnaire consisting of 16 questions (Appendix B), with the first part of the interview allowing for the participant to offer information specifically on whether or not they used or had used prescription medication and their related conditions. Together with the loose framework of questions, I used some of the interview techniques suggested by Ryan et al., (2007) that allows both the interviewer and the interviewee the freedom to explore experiences or issues as they arise.

This entails moving from a very broad set of health questions to more detailed questions focusing on the persons use of medications, and reflexive questions at a societal level (Ryan et al., 2007). The use of qualitative narrative, following an in-depth interview approach, allowed the participant to connect to the research on a personal level, providing a way in which to go beyond the questionnaire to offering insight into their own decisions regarding their medication routines, illnesses, views and expectations (Hsu & McCormack, 2010). The interviews began with participants voluntarily offering personal information about themselves, their medications and the reason for deciding to participate in this research., which allowed the participant to relax and offer only the information they wished to reveal. Directing their attention to a specific area of their medicines, namely expiry dates, allowed me to explore an area which appears to be one which most people are aware of but few take notice of. The questions allowed me to understand how consumers think and process prescription medication; what information or aspect they consider important and which they do not. It also allowed the participant to be introspective around their behaviours towards medication usage, storage, disposal and wastage. I expected most people to have some form of knowledge with regards to medication recycling/redistribution, but most had not.

All participants voluntarily offered not only the kind of medicines they used, but the illness it was treating, the name of the medication and dosage. (From the information provided to the participant prior to the interview, some had anticipated that the direction of the research questions would cover expiration dates of medication only). When they realised it was going to be much broader, they were quite excited to share more of their opinions, stories and experiences. All participants were eager to discuss and question the possibility of redistributive programs to ensure excess/expired medication could reach those in need of medicine, the people who may not have access to, or be able to afford needed medication.

Some of the questions opened up areas of concern or past experiences with expired medications, partly of which the participant had attributed to expired medications, but in fact had other contributing factors. The 16 questions in some interviews led to participants digging deeper and exploring other possibilities, which led to more questions.

At the completion of the interview I asked for further comments and most did not answer relative to the research, but communicated that they found the research informative and many stated that they had been asking these same questions, but could not find any information which would answer them. I also confirmed anonymity for the participants and all 20 of them asked if their names could rather be printed on the printed version as they were quite proud to have contributed to what they considered innovative research. I obtained consent for this from each participant subsequent to the interviews.

Confidentiality, Anonymity and Storage

Audio data was uploaded into a secure file, on a password protected system, with access only to the researcher and to the supervisor on request. All the audio data was transcribed and saved to the same protected system. Participants names were replaced with an alpha numeric code, the spreadsheet cells containing the participants names were hidden and the worksheet was password protected. A pseudonym (code) was used to identify participants in the reporting (see Table 3).

Reflexivity

Unlike traditional research where the researcher and participant are mutually exclusive, and where the researcher is seen as a neutral observer, narrative, qualitative analysis requires listening to unfolding, unprompted stories of an event by participants, where the researcher's ideology, personality traits and background could change the reciprocity between the investigator and the subject (Karnieli-Miller et al., 2008). The social construction of medication knowledge, highlights the importance of reflexivity, in an attempt

to minimise the problems of interpretation whilst increasing the findings credibility (Dodgson, 2019). Ethical concerns form part of the day-to-day practice of research and reflexivity is something most qualitative researchers are sensitive to and incorporate into their research practice, enabling ethical practice to happen in social research (Guillemin & Gillam, 2004). A person builds their life story so that they can make sense of their self-identity in the present moment. I wanted to understand the roles medication played in the participants 'story', and in order to do so, I would have to elicit more underlying narrative about their healthism, illnesses and medication usage (Ryan et al., 2007). Both the constructionist and individualist theoretical frameworks and social constructionism epistemology underpinned the methodology of this research. I was interested in investigating behaviours toward medication adherence or ignorance of the expiration dates of medicines and the influence this understanding has on what happens within the social context, after a medication has expired. I firstly wanted to look at what an expiration date meant to a patient, such as the importance of it in relation to medication adherence and further how it influenced their behaviour regarding risk, sharing of medicines, disposal or recycling.

I had initially anticipated some of the responses I would get to my research questions, basing it on my own social construction of medication expiry dates and lived experiences, yet, as an immigrant, from a country not offering state subsidised health, I had not considered the effect of a country without national health being different to one with national health. This process allowed me to acquire new knowledge and was inspiring. Although I lived in the same suburb as some of the participants, they were not informed of this, as to not affect their level of comfortability and anonymity. As someone who has a comprehensive understanding and social interaction with medications, I found myself reflecting on my own assumptions and was alerted at times, to new concepts, ideas and explanations, and surprised myself with an inner voice thinking, '*I never thought of it that way*' while mentally noting to

review my own understandings at a later stage. These new understandings did not in any way, deter me from my focus, aim or direction of the research and I was easily able to isolate these moments from the discourse and narratives.

Data Analysis

I recorded the interviews separately, labelling the files according to date and participant pseudonym, and transcribed each one individually into a Microsoft Word document. The transcripts covered the initial 16 research questions, as well as any emerging questions, experiences or opinions, which arose from the interviews. The transcripts included all the conversations relating to medications, pharmaceutical companies, proposed redistributive programs and general opinions on the medication industry. I also included in the transcripts, all the participant SES and demographic data obtained during the interviews, as well as any stories and experiences the participants wished to share. I also saved the transcripts, using the participant pseudonym codes to identify each transcript.

Once transcribed, each transcript was printed out and I read through each one thoroughly, to identify core data, highlighting as I progressed. The data identified in the transcripts as important, was inserted into an Excel spreadsheet and open coded. I also coded the data into the analytical software, NVivo, to ensure I revealed as many themes as possible. There were 30 patterns and themes resulting from initial coding. I further coded this data, to breakdown the core themes into concepts and categories (Floersch et al., 2010), using inductive thinking, which reduced my codes to 12. Whilst analysing the data, I was continuously reviewing, redefining using inter and intra comparison, to ensure the themes aligned with my dataset.

The data was analysed using reflexive thematic analysis (RTA) as developed by Virginia Braun and Victoria Clarke, together with an inductive, latent approach (Braun &

Clarke, 2006), and critical discourse based on Norman Faircloughs discourse analysis (Fairclough, 2003).

Step 1

I first familiarised myself with the raw data, looking to identify those participants who were currently on prescription medicines, their SES, and demographics. I wanted to ascertain whether there was any correlation between prescription medication use and any of these subcategories, for example, was the age of a person an indicator for prescription use? My data analysis was a back and forth process, continuously reviewing and redefining, with my Supervisors help, suggestions for clarification and confirmation that the intended direction was correct.

Step 2

Once I understood the base data, I looked at the reasons for prescription use (condition or illness) and the types of medication treating the illness or condition. I went on to see if the identified conditions were chronic or acute across subjects, and if the severity of the condition or illness had any correlation to a particular demographic. Of the 20 participants, 14 were using chronic prescription medication; three were currently using acute medicines and the remaining three were not currently on any form of medication. I found a correlation between severity of the illness or condition and gender, the correlation being with females; out of the 17 participants who were currently on prescription medicine for chronic conditions or illnesses, seven were female.

Step 3

I moved on to closely looking at the rationality behind why the pharmaceutical industry uses medication expiry dates, as understood by the participant, and whether they checked the expiry of medicines when receiving it, as well as the logic behind the actions. I wanted to understand the foremost understandings of expiry date use, through the lens of the

participant. I also wanted to see if this fit with any documented reasons or differed drastically. Some themes were beginning to emerge at this stage, both in the excel spreadsheet and NVivo, they were –strategy & misconstruing (reason for expiry dates on medications); trust – (why participants do not check expiry dates on new medications when receiving them); risk – (why participants do check expiration dates of old medications); conspiracy – (what happens if expired/excess medications are recycled or redistributed); Severity – (conditions) and uncertainty – (the 'why' of participants actions). The themes generated were reviewed and rechecked against the data as per Step 4 of the six step thematic process developed by Braun and Clarke (2006). This was the start of the thematic map coming together.

Step 4

I next identified which participants would use expired medication and why or why not; and if any, what risk participants considered by doing so. I also wanted to find out if this 'risk' taking extended to others such as family members or friends. I was interested in what circumstance, belief or knowledge would motivate or convince the participant to use expired medications, for example, was it a belief that there was no risk involved or did it go beyond that to more socially constructed ideologies; did this 'risk' taking extend outside of their personal sphere?. I went on to analysis these beliefs or learned behaviour across all participants. Once I found a pattern, I moved on to investigate what type of medications participants would definitely not take after expiration and the reasons behind the avoidance of these particular types of expired medicines. This was to get an understanding of if, and how, participants thought about danger of expired medication use, but more specifically if this was related to all drugs or only a certain category of drugs; and if so, what types of medicine they attributed their feelings to. There were definite themes emerging that risk and danger were not a concerning factor to the majority of participants when considering the use of expired

medication, however there were commonalities between categories of drugs they considered ‘dangerous’ after expiration and would not use.

Step 5

The next step was to find out if participants understanding and actions with expired medications had any bearing on how they stored, disposed of, or considered recycling of medicines; as well as if they had any knowledge of current initiatives of and for the development of redistribution and recycling programs. I wanted to also determine, based on their medication knowledge and healthism, if they would support such programs. After the first round of analysis, I went back to the coded data as well as the transcript and reviewed, considered and determined what I was seeing in the themes and patterns emerging. I also relooked at my initial assumptions of what participant responses would be, to see if they aligned or were totally disparate. Were expiry dates of importance to a patient and what risk did they see in taking expired medicines, if any?. If the participants found taking expired medicines was not a risk, then I wanted to know why; and how far this risk extended outside of the participant themselves; and if it did not, then why? I again did this across all participants.

After the themes were established, with clear definitions and supporting data within the transcripts, I wanted to analyse the overall stories the participants narratives were telling. I wanted to see how the participants constructed their narratives and how they positioned themselves with regards to their personal discourses. I was interested to see if the participants way of thinking about prescription medicines, and medication practices for themselves, would be the same for others; as was the case with many participants who claimed they would have no problem using expired medication but when asked if they would extend this to parents or children, I saw a complete turnaround in considerations. I relooked

at the theories I had considered in this regard, and found the same things proposed as significant to prescription users, was evident in the discourses.

Step 6

The final part of the analysis was to determine if participants had any knowledge about initiatives to collect, recycle and redistribute medications, whether in NZ or outside of NZ. I further wanted to know if the participants would support such initiatives and to what extent. I was specifically looking for the principles on which participants based their discourse and found a clear divide between for and against; with some ideologies not necessarily based on fact but on socially constructed understandings of the outcomes of such programs. The data analysis was a constant check and recheck process as there was minimal prior research available specific to individual beliefs, actions and experiences with expired medications. The findings will focus on the socially constructed meanings of expiration dates of medicines and how this effects the actions of prescription medicine users, across their social and family lives; as well as how, a change in understanding of medication expiration and the access to more available factual information regarding legislated and monitored redistribution programs for expired and excess medicines, could benefit patients and those unable to access prescription medicines for whatever reason.

Chapter 4

Findings

Understanding of expired medications

The findings focus on the experiences of people who use prescription medicines, their thoughts and understandings of expired medicines and their views on why expiry dates are used on medicines by pharmaceutical companies. The complexity of social interaction and medicines was evident in the discourses, suggesting that the understandings of people is often different to the intent of the pharmaceutical manufacturer and the expectations from dispensers and legislators concerning the adherence to medications (Kennedy et al., 2017). All participants are from similar socio-economic backgrounds and demographics; however the nature of conditions and illnesses are diverse, thus the medications which they keep in the homes are diverse as well. Each participant took sole responsibility for their own medication routines and management, with some also having the responsibility of medicating others, such as children or parents. The participants spoke passionately about their understandings of pharmaceutical involvement in medicines and the interactions they each had, but also about their unhappiness with how they perceived medicines to be marketed and legislated (Parker & Pettijohn, 2005). Many of the participants felt bound by outdated policy around the further use of unwanted or excess medications with strong convictions that prevention of achieving this goal was a strategy by pharmaceutical manufacturers and a 'road of least resistance' attitude by legislators. It was also found that the participants believed the shelf life of medications to be too short which drives a passion for positive change in current law for extending medication shelf life (McRae et al., 2016), and they also consider such a change would assist those in need whilst contributing to the minimisation of the global impacts and environmental effects of wastage. Each participant believed they had a role to play in managing their own medication use to its utmost benefit, but there is stronger evidence of a

belief of obligation to ensure all people have access to the medication they need (Capron, 1984). Unsurprisingly none of the participants considered their beliefs or actions about these issues, political, despite confirmation that they are concerned with motivating a change in medicine use laws to entrench acceptability of social actions, which they understood were already in existence (pharmacists currently sending expired or excess medicines to the Islands). The findings revealed four main areas in the constructed discourses relevant to the use, compliance and adherence to medication regimens: differing interpretations of medication expiry dates, checking medication practices, risk of expired medications and how to address wastage. These will be discussed in turn.

Different interpretations of medicine expiry dates

When embarking on this research paper, it was crucial to obtain current definitions of medication expiry dates. The FDA defines expiration dates as "*reflecting the time period during which the product is known to remain stable, which means it retains its strength, quality and purity when it is stored according to its labelled storage conditions"* (FDA, 2022) and ARL Bio Pharma, a contracted testing facility for the pharmaceutical industry, explains expiration dates of medicines as "*The date placed on the container/labels of an active pharmaceutical ingredient (API) designating the time during which the API is expected to remain within established shelf-life specifications if stored under defined conditions and after which it should not be use*" (Vu, 2022). There is a tremendous amount of information available on the use of expiry dates by the pharmaceutical industry, however there is currently no available research on how patients and the general public interpret and determine meaning from these dates. There is also no scholarly base to work from on patient understandings or meanings of medicines and their expiry dates. I aim to build a picture of how people understand expiration dates both from a worldview and theoretical perspective and understand specifically the how and why of medications.

Although pharmaceutical intentions for the use of expiration dates is well known within the pharmaceutical industry and prescribers, there is not a lot of understanding through the lens of the patient and public of Aotearoa, New Zealand. I wanted to know how people define meaning and actions from their relationships with medicines. The participants lived different relationships with medicines depending on the patients age, chronic health condition (if any), personal culture and own belief systems around health. For example, medications were integrated into the participants daily lives in various ways and moreover there is evidence of a 'taken for granted' nature displayed by people when consuming medications. Most people do not consciously consider or look at the expiration date of a medicine, however in the considered "high risk" group of medicines, people will acknowledge risk and conform to expiration dates relevant to how important the medicines are to their health.

Checking medications for expiration dates

Most of the participants indicated that they took little notice of expiration dates on any medicines when they collected them from a pharmacist. There was an assumed level of trust in the pharmacist at this point in time. The amount of information required at the time of collecting medications varied depending on how familiar the medication was to the participant and how much information the pharmacist was required to communicate regarding important storage or other instructions contingent on laws and regulations around the medication. This difference was also reflected in participant views around expiration dates of prescription medications. Participants displayed different viewpoints as to why medication expiry dates exist, most of whom (14/18) claimed they are used by pharmaceutical companies to indicate the last day of efficacy, as was Sophie's understanding.

***Sophie*:** "*Expiry dates are there to tell people when meds are no longer effective"*

Participants also believed that this was the date where risk increased, so the date was indicative of a safety risk and therefore any consumption of medications after this date required careful thought. Although participants felt that expired medications required more consideration than non-expired medications, they all agreed that circumstance played a major role in any decision to consume medications past their expiration date.

> ***Sam*****:** "*I would be more careful with expired medications than those not expired and weigh up circumstances against the risk* "

Trevor felt strongly that expiration dates were a marketing strategy by pharmaceutical companies to sell more products, with Sania, Dan and Hugh supporting this argument and Sophie convinced that it was a strategy by pharmaceutical companies to protect them from any potential legal issues. This was also revealed in other discourses.

> ***Trevor "****I know they say it is to indicate best time to use medicines but I personally think they use them because it is better for sales and to sell more products"*

However, interestingly there were also varying perceptions based on the age of the medications which I discuss next.

New medications

New medications to participants meant those medicines dispensed to them by a pharmacist. Old medications are those medicines the patient has access to from earlier dispensings regardless of whether used or not. For example, Colleen explained that any medications collected but not used were considered old medications once placed in her home.

> ***Colleen:*** *" New medications to me are those I have a prescription for and the pharmacist dispenses to me. However, if I put them in my medicine cabinet at home, whether I use them or not, they become "old" medicines even though technically they are still new. I hope that makes sense"*

Most of the participants did not check expiration dates of new medications. This partly was an assumption that newly dispensed medications are not going to be expired, so there is no need to check the dates. However, 50% of the participants mentioned that they trusted the pharmacist to dispense new medications.

> ***Sam**: "I do not check the expiry dates when I get new medicine because I trust the pharmacy. I hope they would know not to give expired medications to patients".*
>
> ***Kial**: "I assume if I am being given medicines by a pharmacist, that the medication is new".*

Four participants used expiry dates to sort their medicines into chronological order and six participants did check expiry dates on new medications, but could not give a reason why, attributing it to an unconscious mental process manifesting in a physical action.

> ***Nicole**: "I check the expiry dates when I get the medicines, but I am not sure why"*

Newer medications were seemingly trusted more than older medicines, but this trust is not necessarily for the efficacy of the medication, but indicative of trust of the pharmacist, believing that the dispenser would only dispense 'good' or non-expired medications. However, the trust is not universal perhaps reflecting the idea of a 'responsible and good neoliberal consumer' rather than blind faith in a system that can be prone to human error.

Tsz-Ting established a connection between medication expiry dates and food, which highlights the potential risk of placing medicine and food on an equal playing field. Certain expired foods can have serious adverse physical effects on a person if expired and or stored incorrectly, whereas most medicines will simply lose potency.

> ***Tsz-Ting:** "Medicine to me is no different from food. Like food has an expiry date, meaning it has best quality before that time and expired medications are not at their best quality after expiry".*

Date labels in general have a severe impact on a consumers decision to dispose of a product, which is evidenced in the vast amounts of global wastage in both medications and food. Food manufacturers use several variants of date labels with no information other than a short explanation such as 'best by; sell by; use by; fresh by'. Research shows that consumers dispose of perfectly safe and consumable (edible) product dependent on their perception of the meaning of a date label. Several antecedents such as risk perception or previous experiences to food borne illness shape a person's perception and their interpretation of a date label. The food industry fosters consumer confusion by lack of information or drives to educate the public to the actual meaning of food labels. Literature supports that this confusion leads to substantial wastage and there is a growing movement to have the consumerist 'language' of food labels legislated in policy, to address the substantial wastage of food that is perfectly safe and edible (Wilson et al., 2017). In the USA, 'The food date labelling Act' was introduced in the Senate in May 2016 to address this issue and set policy to change the way food is labelled (Tsiros & Heilman, 2005). There is no research to support such an initiative is underway for medications.

Old medications already in the home

Older medications that were already in the lives of the participants were subjected to more scrutiny as it is felt that the responsibility no longer lies with the pharmacist but themselves. Of the 20 participants 18 participants admitted to checking old medications at time of use but two participants, Kial and Sam, said they did not check old medicines at all. Two other participants said they would never take nor consume expired medications. Interestingly, none of the participants mentioned disposing of medications which they identified as expired but considered the storage of medications. So while strategies to prevent harm to themselves or other family members were in place, there appears to be

confusion around what to do with the identified expired medicines which is discussed in the final theme.

> ***Gunther****: "I check my old medications regularly to ensure I am not storing expired medications. Most things have an expiry date, such as food. Medications serve a specific function and I trust the manufacturer to know when the medications are best for".*
>
> ***Simone****: "My late mother used an expired inhaler. The doc kept giving her repeat scripts without consult. She didn't always check whether they were expired. I believe this left her with worse chest infections and spores were found on her lungs. So I do check my old medications and would not risk taking expired medications due to this experience".*
>
> ***Kial****: "I do not check expiry dates of old medicines. Why should I? If it looks good then I would use regardless".*
>
> ***Sam:*** *"No I don't check my old medications. Possibly because if I have any at home they are not high end meds and if I have prescription meds I would complete the course and I don't believe expiration dates have any purpose other than to make us buy more medicine".*

As the quotes above suggest, most of the participants stated checking old medications was to avoid risk and maintain safety but a few did not care about expiry dates such as Kial and Sam. For these participants they positioned the medication expiry dates as a marketing technique. This is in contrast to the majority of participants who worried about effectiveness and safety of expired medications.

The way the participants discuss medications is significant and builds a picture of the individual's health literacy. At times medications are talked of as chemical compounds and active ingredients so the medication is very much seen from a biomedical lens and from this

perspective it would suggest that active ingredients can become inactive or ineffective (despite the participant not being a chemist) (Sundar et al., 2012). However, for others because more medications are ingested the discourses of expiry dates are compared to other things that we ingest such as food. In this framework it is assumed a more societal level of protection and that these dates are put on ingestible compounds to protect society (Kaufman & Novack, 2003).

As with a lot of remedies and experiences for health, the participants experiences, social context, culture, and upbringing are important to consider when they are making sense of expiry dates. For example, Simone's experience with her mother has reinforced that expired medications may not be as effective and even dangerous to a patient's health. While most participants stated that expired medications were risky this again was for two main reasons – one biomedical views (Coveney et al., 2019) (just will not work as well) and two, like eating expired food there may be consequences such as non-fatal symptoms (Hall-Phillips & Shah, 2017). Some participants such as Tsz-Ting, had been taught life lessons around medications since childhood and believes and acts on these beliefs and trust.

> ***Tsz-Ting:****"I do check old medicines to see if they are expired because I think if you use expired medicines you get stomach pain; vomit; diarrhoea. Or with skin medication, a massive rash outbreak. Condition gets worse – I don't think expired medicines could kill someone though. This is what I was told as a child and this is what I believe now."*

The conversations around people's actions and processes regarding medications and expiry dates is complex. While most of the participants knew expiry dates were intended to indicate shelf life and loss of efficacy after a certain date, it did not affect the participant storing or using the medications after the recommended period, and most of the subjects were unconcerned about risk of adverse reactions. This could be attributed to a psychological and

social phenomenon termed social proof, where individuals, in certain circumstances, when faced with uncertainty on how to behave, look to others who they perceive as more knowledgeable about the situation and copy their behaviour. It is the uncertainty that activates the mechanism of social proof and with the arrival of social media, this phenomenon has expanded its reach to a vast global community, which is something that has not happened at any other time in history (Cialdini et al., 1999). This could explain many of the actions seen in patients when making decisions about medications.

Cialdini (1984) popularised social proof theory and developed six principles of persuasion: reciprocity, commitment, consistency, authority, liking and scarcity. The core building blocks of trust are authority and credibility and the reason why individuals who are informed experts in their chosen field, are more influential than those who are not. When patients are dispensed medication from a pharmacist who is perceived to be an expert in the field, patients are more likely to follow and adhere to instructions. It is important to note that even though people fully trust the social proof of dispensers, psychological reactance often occurs once they are home (Miron & Brehm, 2006). Reactance is when an individual perceives a 'threat to their freedom', which motivates the person to attempt to regain this loss of freedom (control) by resisting the authoritative persuasion (Miron & Brehm, 2006). This form of behaviour by participants, was explained as not resisting the rules but simply questioning authority. Much of the participants medication knowledge originated from parents, friends or the internet, and once home, they admitted to investigating the dispensed medicines themselves; and that the results they found, impacted on their decisions and actions.

How medication is understood and stored in households: Patients' understanding of the difference between liquid and solid medication

There were differences in how the participants talked about liquid and more solid medications such as pills or creams, particularly in relation to expiration dates and it was found that liquids were subjected to more scrutiny than pills. Creams and lotions were considered dependent on where they were applied on the body but were not seen as risky as liquid medications. Some of the discourse was related to the temperature at which to store medicines and some was the location medications were stored in the home, with liquids primarily seen as riskier than solids. None of the participants considered pharmaceutical recommendations for storage and simply placed medicines in spaces convenient to them such as kitchen cupboards, bathrooms and fridges.

Eight participants indicated that they believed liquid medications require different storage methods and locations to more solid medicines but they did not necessarily consider temperature to be associated with correct storage methods. The biggest concern of participants, with regards to liquid medicines is that many believe, all liquid medicines develop bacterial growth once expired. However Kath believed that solid medications posed more risk and danger than liquid medicines.

> ***Kath:*** *"I would worry about any pill after it has expired but I am not concerned about liquid medication".*
>
> ***Sophie****: "Liquids are easier to get bacteria".*

The discourses about why the participants had this understanding, revealed that this is what they understood from information received from various sources such as the pharmacist, other patients or their own research. It is not surprising the consumer of medications gets confused as to storage and handling of medications as was seen in the next two examples. Winter et al., (2013) set out to determine how emergency medical services drugs hold up in

different real world conditions, under recommended storage conditions, room temperature and inside emergency services (EMS) vehicles. Five medications regularly used by EMS – Cisatracurium besylate; Lorazepam; Methylergonovine maleate (MM); Succinylcholine chloride and Adrenaline Hydrochloride (AH), were studied for a period of one year with sampling intervals in weeks and months. It was found that AH and MM remained stable for several months even at room temperature or inside EMS vehicles (De Winter et al., 2013) whereas Medsafe's directive gives specific storage conditions and temperature for Aspen Adrenaline (NZ's AH), as per point 6.4 of the Medsafe data sheet which states *"Special precautions for storage – store below 25^{o}C. Protect from light".* The other example related to eye drops which was specifically mentioned by participants in this research, is from Lin et al., (1999) who studied fortified eye drops regarding potency and deterioration in relation to specific storage conditions and temperature. Lin and colleagues found all fortified AB eye drops can be safely stored in a home refrigerator or freezer for up to 28 days without deterioration. They also found that temperature had no influence on the prescribed effect within four weeks, whereas the Medsafe data sheet for fortified eye drops, whose role is to keep the people safe and reduce the risk of medication, states - *" keep in a cool place where the temperature stays below 25^{o}C. Do not freeze the eye drops. Do not store it in the bathroom or near a sink. Do not leave it in the car or on windowsills. Heat and dampness can destroy some medicines".* This ambiguity and inconsistency of such conflicting evidence highlights the possibility for misconceptions of medicine practices and also the highly regulated nature of medications. It is unlikely that people will go to the same lengths as these researchers to explore the research behind the effectiveness of expired medications, however it does suggest that there is the potential for recycling of medications.

Risk and understanding of expired medications

Clearly, risk and safety of prescription medications is important with increasing importance for older medications in the home, and particularly liquid medications. It is interesting to note that while risk and safety was mentioned by all participants, despite this, I found that most of the participants would use expired medicines and do not fear any serious risk in consuming any expired medications. However, three participants were concerned about the risk of consuming expired liquid medications. Such decisions are made in the context where there is research that shows that most medications are safe to use past expiration dates, but acknowledge that there is a possibility of diminished potency. However most regulating agencies insist that expired medications should be disposed of despite contradictory evidence. What was highlighted already and will be discussed further is that disposal instructions are not well communicated or understood.

Why participants would or would not use expired medications and conditions

Gunther felt there is no situation where he would risk the dangers and toxicity of using less effective, expired medications. He trusted the manufacturer and dispenser to know when not to use a medicine and therefore would not use any medication past its expiry date. Other participants were conflicted, agreeing in principle that expired medications should not be taken but they would consider using expired medicines in certain situations. This context plays an integral part in the decision to use or not to use medicines after expiry date, situations such as emergencies, late at night or an onset of extreme illness, unable to access a physician, or not something they can obtain at a pharmacist and requires a prescription. Sania spoke of how she suffers from debilitating migraines, indicating that the resulting pain would overrule her normal behaviour towards expired medications.

***Gunther**: "I would not use expired medications because I won't get the same effect if expired. The dates are there for a reason. Could be dangerous or toxic if expired".*

***Sania**: "Sheer desperation. Pharmacy closed and I have a terrible headache".*

Tsz-Ting suggests that expired medications could be used in an emergency but for her this action would come with worry and guilt.

***Tsz-Ting:** "I myself believe we should not use expired medications, however I have used them in the past for fever, in China, when I could not access anything else. However, I felt very uncomfortable and guilty about it as I was violating the idea that I had been told for a long time".*

Barend said his parameters for use is time, which is a maximum of two weeks past expiry and only in extreme circumstances, plus Barend only trusts medication that he has been in control of – not others. For Kath, she considered that expired medications might be alright for her to consume, but was adamant that she would never give expired medication to her children. This illustrates that taking a risk for one's own health might be acceptable but that children need protecting and the rules for medicating children are potentially more important. However, the decision to use expired medications or any perceived risk involved, is not that simple in that circumstance and outside factors play an important role which may overrule the individual's normal risk practices.

***Barend**: "If only one or two weeks old and I knew where it came from and it was in the right conditions (not in sun), I would use the medications. I would not use exp meds from someone else. If I had a massive headache.*

***Kath**: "Depends how much it has expired. Never for the kids. Two months is okay, one year no. If still effective why waste?".*

Trevor considers his experience in the paint industry, (where expiry dates play a role in the consistency and toxicity of the product), influences his understanding and practice of medication use, particularly expired medicines.

> ***Trevor****: "I would possibly used expired medicines. I used to work in the paint industry and I still do DIY. Paint has an expiry date and shelf life, after which it's not as effective and can cause some hazardous symptoms. I feel this also applies to medicines".*

How people negotiate risk and expiry dates of medications is complex from the meaning and context of expiration dates on other products (food and paint), how a medication looks, how it has been stored, who the medication is for and for what condition. However, individuals had differing opinions and practices dependent on the situation with necessity overriding the expiry date at times. Caring for others added a layer of risk that meant expired medications were not considered safe for children by the participants with children or the elderly of those with elderly parents or patients.

Understanding of what happens if expired medicines are used

There is the possibility of potential harm, that may occur from taking medications after expiry, or taking medicines which have not been stored according to the manufacturers conditions, so it is important how people consider what might happen if they did take expired medications. Adverse effects may differ depending on the type of medicines, storage, brand or the disease of a person. In some medications such as tetracycline, they do become unstable and toxic to other organs once expired and degradation happens, and people with life threatening illnesses may be vulnerable to potential risk (Karch, 2008). This was highlighted in Bobbie's discourse. Bobbie suffers from Type I (T1D) diabetes and requires medication which has the potential for serious adverse health effects for her if it is not effective. As she revealed in her narrative, this did happen when she used expired insulin. Prior to this

incident, Bobbie did not consider any danger with using expired medications and had not been made aware of the potential risks of doing so by a doctor or pharmacist.

> ***Bobbie****: "One day my insulin wasn't working, so I took another dose and my sugars were not stabilising, so I took a third dose. I then checked the insulin bottle, and it was expired. So, I would not use expired medications as in my situation it could be dangerous if the medicine does not do its job".*

Bobbie, as a result of this experience, changed her medication habits and now consistently checks the expiration dates of her insulin, however would still consider using expired medicines that did not present an adverse effect or health risk.

Research supports the actions of the above for T1D people who are unable to access insulin for whatever reason. This incurable autoimmune disease requires regular doses of insulin, without which T1D people will develop hyperglycaemia and die within days or weeks (Willner et al., 2020). Even short occurrences of hyperglycaemia can unexpectedly cause complications to the microvascular system such as kidney failure or nerve damage as well as potentially fatal diabetic ketoacidosis (DKA) (Wu et al., 2020). Willner et al., (2020) showed in their study of T1D patients that patients with an immediate life or death need for insulin were prepared to take desperate measures to secure insulin and avoid health complications, with one participant claiming *"We are dependent on insulin to live. When we can't obtain it we want to do anything to live and look for any method to get insulin".* This was echoed by other participants in the same study, with statements such as *"When I couldn't afford medication I resorted to using insulin that was denatured by high temperatures"* and another admitted to using expired insulin when they were unable to access new refills.

Sophie and Sam however, neither of whom has a chronic illness, feel that there is no risk with using medication which is past the recommended date of use. Sophie claims that she has used expired medication and it was even effective in treating the condition.

> ***Sophie****: "I used exp meds for depression and they did nothing to me and were effective in treating the illness". The most risk is that they won't be effective and prevent been treated properly.*

The willingness to use or not to use expired medications does not appear to be gender specific to either gender, demographics or socio-economic status. Although the differences reflected were not due to any obvious common factor, the participants' circumstance and experience did play a significant role in decision making, and experiences were more prolific in the older participants.

Expired medications patients would never use

Although most of the participants were generally not concerned about adverse side effects from using expired medicines, there were some specific medications they would not use, the main ones being Insulin (5/20); Antibiotics (2/20); Liquids (5/20). Discourse around these particular medications revealed different reasons for the decisions. Sania mentioned that she would not consume any antibiotic after expiry as she is allergic to one particular brand of antibiotic medication and she would not know which ingredients of an antibiotic she is allergic to, and that she does not know what happens with antibiotics after they expire. Sam however would not use any medication which had been opened as he was concerned with bacterial growth, and believed that opened medications attracted bad bacteria.

> ***Sania***: *" I am allergic to one particular antibiotic. I wouldn't know ingredients of other antibiotics and wouldn't know what happens after exp date"*

***Sam**: "I would not use medications which were opened. If medicines are opened and not stored correctly they could get bacteria"*

Barend felt the risk of using expired sleep medications or anti-virals was high as these types of medicines would not treat the condition effectively and result in worse health outcomes. He considers these types of medicines to have stronger pharmaceutical compounds and ones which require them to operate at full potency and potential to achieve the desired health results. This indicates that the risk perceived by some participants is around the medication not having enough potency to treat the condition as opposed to suffering adverse side effects. Barend also admitted that he understands the word 'anti' to be one of negativity and therefore associates any medicine prefixed by 'anti', to be 'bad' instead of the intended meaning of prevention. His understanding also highlights the gap in appropriate information available to the general public on whether expired medications are harmful when he says *"....as I don't know enough about it*". Barend has a strong biomedical view of medications but at the same time demonstrates uncertainty around expiration dates. It also highlights the potential for public mis-interpretation of medical terminology and a gap in educating the general public.

***Barend**: "I would not use any medicine which is used to treat sleep problems or any anti-viral medication. These types of medicines are strong and deal with the nervous system and are receptor uptakes. For example, sleep meds may be ineffective and actually interrupt sleep. Anti-virals just sound bad – to me "anti" doesn't go with expired and as they are attacking a virus they need to be strong and not less effective. But I am 50/50 on whether expired medications are dangerous or not as I don't know enough about it".*

Other participants associated the possibility of adverse side effects to particular medications, as was the case with Aiden and antibiotics. Aiden's previous physiological reaction to antibiotics was unpleasant and he does not consider this reaction to be due to any other factors, such as when he took the antibiotics or whether he took it with or without food. Aiden therefore now assumes that 'gross' reactions will occur with taking any antibiotics and resulting in even worse symptoms if antibiotics are expired, using past experiences to build on his existing health and medications knowledge.

> ***Aiden**: "I wouldn't use expired antibiotics. Antibiotics already make you feel gross when not expired, so I can imagine what they would do if expired. Something would happen".*

Carl spoke about his concern with the amount of sugar in particular medicines such as cough syrups and his understanding that sugar encourages bacterial growth in the cough syrup once opened.

> ***Carl**: "Liquids/cough syrup/laxatives or others loaded with sugar, are the meds I would not use if expired because if opened or expired could have bacteria ".*

In reality, sugar is used to mask the bitter taste of medicine with sugar syrup being a known soothing agent in cough medicines (Eccles & Mallefet, 2017). Carl's understanding of the effect of sugar on opened medicines is anecdotal evidence, with no research finding a connection between sugar and bacterial growth in cough syrups. While there is no scientific research about sugar and bacterial growth in liquid medications there is strong and supported evidence that the sugar in medicinal syrups has a correlation with tooth decay (Durward & Thou, 1997) which none of the participants mentioned. Al Mamum et al., (2014) found that some medicines, including liquid syrups, have reduced product quality due to the survival and growth of micro organisms which may be harmful to some patients, but such bacterial growth results from non-sterile manufacturing practices and not the deterioration of the

medicine itself. Plus there is evidence to confirm the possibility of bacterial growth in some liquid medications but as a result of unhygienic practices within the home, such as drinking from the bottle (Baird et al., 1979).

Patients understanding and support of solutions for expired medications

The discourses suggest that severely expired medicines were used to treat chronic conditions without any adverse side effects; but with some loss of effectiveness or potency in certain medications. Some of the participants even claimed that the expired medications they used, were effective and had resulted in the desired improvement in health outcomes. It is important to note that participants believe the pharmaceutical industry and government medical bodies are not giving the general public enough credit in the ability to question information which they believe is not based on sound evidence. With this belief, people are making their own decisions based on their own and others experiences and information found through various other mediums. The discourses reflect low trust in public health information of medicine use, particularly around expiration dates, such as Sania, Dan, Hugh and Sophie, who expressed their concerns around the strategies of pharmaceutical manufacturers used to protect the manufacturers legally and to sell more products.

> ***Sania:*** *"Pharma are constantly having trials of new meds and by putting expiry dates on, people will throw out these medicines and buy new ones. It's just a marketing strategy".*
>
> ***Sophie:*** *"Expiry dates just protects Pharma from legal issues, and most medicines are perfectly okay to use after expiration date. I would use expired medications".*
>
> ***Dan:*** *"It's a marketing strategy to get people to buy more. I have used nasal sprays which are expired for more than two years and they still work, but not as strong".*
>
> ***Hugh:*** *"It's just to generate more sales for the big Pharma's".*

The findings show that most people would use medications after the expiry date but with some thought about potential risk, and that circumstances play a pivotal role in the decision to use expired medicines, such as medicinal shortage, access or affordability. The wastage of seemingly usable medications was a strong motivator for some participants to store and use older medicines with most believing that there is not enough credence in the pharmaceutical industry's justification for disposing of expired medicines. The narratives reflect that the participants display some healthist views and feel a personal responsibility for their own health as well as the environment, evident in their decisions to use medication which is expired. They argued that they had found more support for the use of older medications than not and therefore did not consider diminished efficacy a problem significant enough to influence the disposal of usable medicines or to add to global wastage.

Recycling or disposal

The world of medicines is a consumerist market where drugs are just another commodity and where it is cheaper to dump than recycle, regardless that recycling solves two problems, that of the person unable to access or afford medicines and minimisation of the large amount of global unused medications. The discussions around disposal evoked several connected emotions and the participants spoke quite fervidly about this step in a medicines life cycle. Whilst many felt that expired medications should be disposed of, they also admitted that they only had information which was told to them by pharmaceutical manufacturers, dispensers or doctors, to base these actions on. Tsz-Ting highlights her reflex process and trust of authority when she follows what she has been told since childhood of what to do with expired medications. She trusts this advice from her parents, who obtained it from the pharmacist, and who they considered, a reliable, informed source.

Tsz-Ting: *"When I find expired medications, I throw it away, even if I have a lot left. I was told as a child not to use expired medicines of any kind because it may have a negative effect on my personal health. My understanding of how to use, dispose or store medicines is from my parents, however they don't influence my decisions, as my parents were told by the pharmacist not to do this and therefore I am influenced by the manufacturer who decides these dates and they know what is the best day for you to use medicines".*

Despite recommendations to dispose of expired medications, some participants believed that although they would not use medicine after expiry, expired or excess medicines could still benefit others in need of medication that those individuals may not be able to access or afford. The participants are aware that there are many individuals who are 'stretching' or sharing their chronic medication due to either the cost or the shortage of these medicines, resulting in non adherence to the medication regimen, which has the potential for adverse health outcomes. For these reasons all participants confirm they are supportive of medicinal redistribution, but have concerns unrelated to quality or danger of expired medications, but rather related to policy and strategy. Only two participants did not believe recycling to be a good idea, however they did state that this was due to the public information about the 'dangers' of expired medicines and feel it is too risky to take a chance with expired medications themselves, but are supportive of redistributing excess medications which are not expired.

Vea*: "What's the point of keeping or redistributing expired meds, if they are no good?, unless medicines can be checked for safety for re-use".*

Although David would not and does not use expired medications himself, he would support a well managed redistributive system for excess medicines and those medications which are expired, but which have been checked and approved for further use. David would

prefer all people to be able to get the medications they need, however he is aware that there are a number of individuals who are not able to access their required appropriate medicines due to certain barriers. For this reason, David is concerned that without a suitable system and program to redistribute medicines, people may turn to potentially dangerous sources to obtain their medicines and for this reason would support a legitimate redistribution programme.

> ***David:*** *"People who don't have access to free meds or have little opportunity to get it, may get to the point where they may consider meds not from reliable source".*

There is currently little public information available on what to do with excess or expired drugs in NZ and what information is available, is difficult to find. The information on Medsafe NZ's web page is not sufficient and to reach even this basic information individual's have to navigate as follows: *Home page -Safety –Taking medicines safely - How to dispose of medicines safely*. The information is located at the bottom of the page, and simply states *"Do not keep old medicines because you think you may need them in the future. Return unused medicines you have been prescribed, or medicines past their expiry date, to your pharmacist for safe disposal".* This is further problematic in that most pharmacies do not accept returned medicines as there is no government assistance for the cost of disposal. Auckland Council started the *Dispose of unwanted medicines properly* (DUMP) campaign, which is quite informative, (see Figure 7) however there is little awareness of this project and again information provided, advises that excess or expired medicines should be returned to pharmacies. The assumption is that any and all pharmacies are part of this initiative, but in actuality, only community pharmacies participate, and then only certain of these community pharmacies accept returned medications for disposal.

Figure 7: *DUMP project*

Note: From Safer use of medicines, Saferx, 2019, p2

The findings show there is a serious misunderstanding of what recycling of medicines in NZ means to the general public. The participants confirmed that their understanding of recycling means to reuse a product, whereas in NZ medicinal recycling refers to the collection and disposal of medications. They questioned why only the packaging and not the medication itself is recycled, when government calls for people to recycle medicines by returning them to a pharmacy. Participants do not accept that it is not possible to recycle medicines, if it is possible with most other worldwide products, shown in Trevor's explanation that other products such as spectacles are repurposed, so why not medicines.

Trevor: *"Yes, medicines should be recycled. Like you give old glasses to specsavers, I can't see why medicines cannot be treated in the same way".*

There is strong evidence that people are increasingly more environmentally aware and this awareness is filtering into their health conscientiousness as is shown in the NZ and global awareness of climate change. The participants concerns regarding wastage and strong feelings towards recycling, were evidence of this.

Barend*: "Can medicines expired or excess, not be recycled in the true sense?"*

Carl spoke about how most lay people do not know what should be passed on to others and acknowledges that wastage of most things is a common human trait. Despite these admissions, Carl believes that the general public should be given more information on expired medications, what process to follow once they are expired and more insight into what happens to recycled medications once they are returned to pharmacies. Carl also highlights that although policy and legislation is to dispose of medicines which are past their shelf life, there are many pharmacies and organisations who are, in the absence of legislation, openly collecting and redistributing these medicines to those in need.

> ***Carl**: "The average person does not know what is good to pass on. People are wasteful creatures and if medication can still provide some care for people who can't afford it or get access to it, then medications should be recycled. But are they recycled or just disposed of?". I had an experience years ago where I was told to take my expired medicines to a pharmacy in Onehunga, and they would send them to the islands".*

Most of the participants felt that government agencies and pharmaceutical industries are purporting to recycle medications when in fact, they are meaning disposal and they argue that this is tantamount to 'false advertising' and misleading the public. Carl felt that most people would happily buy into a recycling programme, however government need to be 'honest' about what current recycling means. The discourses reveal that individuals understand that the recycling of medications may differ slightly from other recycling processes of other products, however they see no reason why this cannot be operationalised with medications. It was also evident that participants had thought past the donation phase of recycling and considered what further processes might involve, such as donation – check by scientist – test – repackage – redistribute – reuse. This led to discourses of the possibility of corruption in a redistributive chain. Vea describes her experience where people in the islands

can purchase unused medications at a reduced rate through a government programme. She explains that the government purchase these medications at a substantially reduced rate from other countries, however she believes they do so in order to use less of the health budget and to Vea this is corruption.

Vea: *" In the islands, people can buy unused meds from overseas at a reduced rate on a program by the Gov. Gov buys the meds. I believe the Gov are trying to use less budget and it is corruption".*

Sam's concern is the potential for corruption in a redistributive programme if not managed by the same concern at both ends of the chain and the possibility of pharmaceutical interference to scare people away from supporting a redistribution initiative due to reduction in medications sales.

Sam: *"My concern about such a programme would be corruption at the beginning or end of a distribution line. That Pharma sales would be cut and they would not be happy, so would use media to instil fear of expired med use".*

Redistribution

There was both support and concerns about redistribution which are discussed next.

Support

Only two participants had some knowledge of redistributive efforts to pass excess and or expired medications on to those in need and even those two were vague about what it would entail. Most of the participants had not heard of an initiative to redistribute medicines. A brief overview of such a programme was explained to the participants which resulted in the participants eager to explore the subject further. Many of the participants offered that they would support redistribution of medicines if strict checks and balances were in place, with only two participants stating they would not support a system such as this at all. The majority of participants who were totally supportive of such an idea, spoke about having strong views

and beliefs about what could and should be done, but is not. They felt that it is a simple solution and questioned why it is not already in place, citing the pharmaceutical industry as the main barrier. They believe that this industry does not want to encourage such programmes, to avoid financial loss and that governments have a lack of interest due to the financial incentives they receive from pharmaceutical companies.

> ***Dan:*** *"A definite no-no to wasting medications. We have food banks in NZ, where technically excess food gets redistributed, so why not medicines for those who don't qualify for National Health or can't get access to the particular product?".*
>
> ***Sania:*** *"I would definitely support the redistribution of excess medicines but not expired ones. I am not medically trained so I look at expired medicines as I look at expired food. I don't have the tools to check for efficacy of medications, but I accept that there have been findings of very old medicines still found effective years later. I would question if that was the medicine or a result of certain storage conditions".*

Some participants also felt that governing agencies in NZ, are influenced by such institutions as the US food and drug administration, simply following other countries in how to approach expired or unused medication rather than taking their own initiative. The discourses are vehement about medication wastage and the environment, with disbelief and concern that the financial cost of wasted medications due to an expiry date is not more of a government concern, citing that those wasted costs could be better utilised in improving current healthcare systems.

> ***Carl:*** *"Absolutely I would support redistribution efforts. The redistribution of excess or expired medicines would prevent hoarding. And if we don't redistribute medications then it is going to waste".*
>
> ***Gunther:*** *"Excess medicines I would support redistribution of but not expired ones".*

Kial: *"There are a lot of lower income and rest homes up North who would benefit from such a programme".*

Thus there was support for redistribution of excess medications, but not universal support for redistribution of expired medications and there were stronger feelings for certain medications which should not be used at all past expiry date. However, this was all positioned passionately from a 'lay person's' perspective. It does appear that the global trend towards environmental issues is filtering through into medications to prevent wastage and environmental impacts and an element of 'taking care of others less fortunate' or social good that was seen in some of the participants discourse and shown in the following examples.

Research shows that major western countries are becoming more aware of medications as a large contributor to global wastage and are implementing and encouraging ways to reduce medicine wastage. The Department of Health, UK for example, commissioned a report to look at the ways the national health system can tackle wastage and improve use of medicines. The plan recognises that everybody, not just the healthcare industry and care homes, but patients and the general public, all have a part to play in stopping avoidable medication wastage. It covers ways to make more effective use of medicines as well as how patients can engage more in decision making about their medications and how to provide adequate health information about medicines to the public and patients as well as healthcare professionals (DHS&C, 2012). This aim is summed up by the previous UK Health Minister Lord Howe when he states *"Ever pound wasted is a pound that could be spent on treating patients. By reducing medicine wastage the NHS will save money that can be spent in other areas of patient care"* (UKGov & Howe, 2011, p2).

Roy (2021) found in his study of the contribution by the healthcare industry to greenhouse gas emissions (GHG) that pharmacists are uniquely positioned and skilled to have

a leadership role in environmental issues. The study found that prescribed and non-prescribed pharmaceuticals make up 25% of the total health GHG emissions, this being the largest of all categories. The economic activities of the pharmaceutical manufacturers are responsible for 90% of these GHG emissions (Roy, 2021).

Concerns

The participants displayed visible concerns about the implementation of redistributive programmes and management thereof. For example, the participants felt that pharmaceutical companies cannot be directly involved in such programmes, in order to avoid bias and negative influence. Participants feel that such programmes should be not-for-profit, privately managed concerns, where none of the links have common interests. The general consensus of those in support of such a program, also felt that the collecting, testing and checking steps cannot be performed by a regular pharmacy or outlet and must have a single focus for collecting expired and/or unused or unwanted medicines for the purpose of redistribution. However, for some participants, cultural reasons suggested this practice would not be supported and as Vea states *"It is playing with people's lives".* Tsz-Ting felt that culture played an integral part in the reuse of medications by someone other than the person it was prescribed to and equally would not feel comfortable in receiving medications not directly prescribed to her.

> ***Tsz-Ting:*** *" I probably would not support redistributing any form of unused or unwanted medicines but not because I am against it, but more of a cultural issue. I can't speak for every single Asian, but personally I would not feel comfortable to give my unused or half finished medicine to someone else and in turn I would not want to receive any donated medication. I can't tell you why I feel this way, it is just something that makes me feel uncomfortable to do".*

Further concern was the possibility of returned medicines being mixed up and the checking and testing process not been performed thoroughly. Sophie was also concerned with the ethical issue of a patient's privacy that such a programme may present.

> ***Sophie:*** *" My concern is that people may return mixed pills for example antibiotics and staff not checking or testing properly. I also have concerns for privacy that it may reveal people's ailments.*

Many of the participants were equally concerned around situations where people are caring for others such as elderly patients or parents and mothers of children. They explained that although they would risk using expired medications themselves, should it be necessary, they would not feel comfortable in taking this same risk for others. The concern in the case of prescribed medicines, is they trust the prescriber and dispenser to issue appropriate, safe and new medications but would be worried about the risk involved for such people receiving expired medication in a redistributive programme.

> ***Vea:*** *"I don't support such a program as they are playing with people's lives. There is a reason that those countries got rid of the medication".*

A large part of the concern was the possibility for corruption during the redistribution process, which participants believed could interfere with and possibly prevent medicines being received by those in need, particularly if the individuals were desperate. A further concern was the ability to test and inspect donated medicines in more depth than an initial 'look and check' of the packaging, to ensure any dangerous medications were disposed of. Other concerns were that the current process is not fully understood by the pharmacists and those involved. Interestingly, many of the participants feel there should be a secondary part of the program, whereby redistributive pharmacies linked to the program, could be active in offering rechecked and tested old medicines to the general public. They added that they would support such a program ,in that if they found one of their own medicines to be expired,

a simple trip to this specialist pharmacy to hand it in, could result in them being able to collect the same recycled medication at a reduced price.

> ***Dan:*** *" I have heard of such programs although I am not certain they are official. A girl I work with has an Aunt in Africa who gets expired medications for redistribution".*
>
> ***Trevor:*** *"I think expired or excess medications should be redistributed but not to third world countries as I worry about corruption in non-regulated countries. Unless a tremendous amount of safeguards were in place as the patient may be desperate and the sender company may not check the integrity of the receiving people on the ground and lead to corruption".*
>
> ***Hugh:*** *" I support redistribution of expired medicines, however I would think there needs to be a solid system and structure, which ensures medication is safe for re-use".*
>
> ***Gunther:*** *" A lot of responsibility would fall onto pharmacies who despatch redistributive medicines and such programmes could have adverse effects. Most would do the right thing but the odd one could be corrupt. I think more focus should be on the way medications are prescribed as in NZ pharmacies supply too much of a product at times".*
>
> ***Simone:*** *"I have heard of donated medications being given to those in need, however I was informed that they only take unopened unwanted medicines and not expired ones. For example, I asked on neighbourly what to do with Celebrex as I had some new pills and I couldn't use them. I was told to take it to a pharmacy who would send it to the islands".*

Thus the participants felt that some redistribution of medications was already occurring in New Zealand but were of the opinion that this was unofficial and they were not entirely sure of this and it was all positioned as hearsay. Clearly there is a lot of

misunderstanding, and potential rumours about medications. It was revealed that when considering the potential for redistribution it is important to make decisions with the communities involved, and not assume a paternalistic attitude and make decisions for entire groups of people on 'what they think is best'. This is demonstrated in the Christchurch based charity Medical Aid Abroad, who accepts all unused, undamaged and in-date medicines from around NZ and redistributes them to developing countries as needed. They also encourage the public to push for local pharmacies to 'recycle' unused medicines to give back to those in need.

All the findings point to the meanings surrounding medications (including expiry dates) being socially constructed. There continues to be tensions between regulatory, experts and lay people's understandings of medications and expiry dates. This is contributing to (mis)understandings and talk around medication wastage, redistribution and expiration dates. If healthcare systems hope to improve medication adherence and compliance, then there needs to be a shift in the way information is communicated. As Dr. Jacinta Mpalyenkana said *"Behaviour is the end result of a prevailing story in one's mind: change the story and the behaviour will change"* (hc-uk, 2022). The 'story' of medication expiry dates, recycling and redistribution needs to change.

Chapter 5

Discussion

The aim of this study was to investigate how medication expiry dates are understood by lay people, focussing on the influence that pharmaceutical expiration dates had on decisions around consumption, storage, recycling, redistribution and global wastage of medicines, as well as to investigate if medication expiry dates influenced adherence or non-adherence to prescription medication. It was important to understand the difference between the way pharmaceutical manufacturers, prescribers and dispensers intended medication data to be understood and adhered to and the actual understanding and subsequent actions by the patient themselves. It was also important to examine if this understanding was unique to New Zealand or in line with global prescription medication practices. Additionally it was necessary to understand the influence that policies and practices had on views and decisions regarding the life cycle of medications and whether these policies were assisting in the minimisation of current global wastage and aimed at providing access to medications by those who may not be able to afford or access essential medications.

Review of Findings

This research revealed that we can understand expiration dates as much more than random dates stamped on a prescription medication. How people make sense of this date depends on the age of the medication (new is something directly collected from the pharmacist versus medication already in the home, seen as ‘old’), the type of medication (relevant to the person which is contextual), if the medication is solid or liquid, if the medication is for themselves or children or older people, and what underlying health conditions the person has. All these factors were shown to influence if a person will consider consuming an expired medication. Unexpected events sometimes meant that expired medication risks were ignored and expired medication was consumed anyway. Storage,

disposal and the potential for recycling of medications was highlighted by varying and often strong views.

Knowledge about Medications

It was evident that people have a wide range of understandings of medications and this has been shown in other research, such as Parker & Pettijohn (2005) who found lay persons perceived that medications were marketed and legislated incorrectly and McRae et al., (2016) who found participants felt the shelf life of medicines was too short. Medicines are more than material objects and imbued with meanings based on the person's beliefs, health literacy, up-bringing and wider social issues such as environmentalism, healthism and concerns such as profit making from health. The discourses around expiration dates illustrated that medications are considered risky, but it was felt by participants that the expiration dates were less of a move to protect society than a ploy to potentially sell more medications. This suggests risk is not the only lens through which people view medications. What appears to be equally important is healthism and this played out in individual responsibility for expired medications once they were in the home and particularly when they were intended for 'vulnerable' people such as children or elderly people. Neoliberal ideals of a consumerist society where the collective good is sometimes lost to the power of a global economy was also prominent in the data reflecting the strong views around policy making.

The results of this study were interesting because the data presented several viewpoints and contradicted many of the initial ideas of the study. Firstly, there was consistent confusion and misinformation about expiration dates in comparison to the FDA and Medsafe's definitions of expiration dates. While this in itself was expected, what was revealed about the social life of medications including the last stage of the medications life cycle from discussions about expiration dates was surprising. The complexity of the decision making, understanding and cognitive dissonance surrounding expiration dates indicated that a

supposed simple date stamped on a package has immense implications for individuals, health professionals, policy makers and Pharmac in Aotearoa New Zealand.

The data supported previous research such as Kennedy et al., (2017) who claimed that people's understandings of medications is vastly different to pharmaceutical manufacturers, dispensers and legislators expectations. The FDA expects the expiration date to reflect the time in which medicines are most effective and stable under specific storage conditions whereas the data revealed that people were convinced that this information was not easily accessible or available to lay people and was lacking sufficient information for them to make informed decisions around medications expiration and that these dates were simply a marketing strategy to increase pharmaceutical profits and did not affect their decisions to use or dispose of a medication.

Consumer Practices

Expectations prior to this study was that people consistently note and comply with medication expiry dates, however this was found to be mostly untrue. The integration of medications, particularly new medications (those recently dispensed), into an individual's life had little to do with whether a medicine was past its expiration date at time of collection, as it was assumed that the pharmacist would not dispense expired medications, revealing an inherent trust in dispensers, polar opposite to the mistrust of pharmaceutical manufacturers and often primary care practitioners. This lack of concern for checking of medications, however, did not cross over into a certain group of medications which was identified as 'high risk', such as insulin. The data showed that for this group of medications, people would check expiration dates, new or old, and acknowledged the inherent risk of using such medicines after expiry. The data indicated that people would also adhere to the medication requirements provided by the pharmaceutical manufacturer for this group of medications. The study further highlighted that a negative experience could change ideas and practices of

healthism, with one participant often using expired ‘high risk’ medication, and unconcerned with doing so, however after an incident where the medication was not effective and which resulted in adverse health outcomes, the person changed her habits of using expired insulin as it could have resulted in hyperglycaemia and possible death. This data is supported by previous research and the actions found common in Type I diabetic people (Willner et al., 2020). It was found that the ‘risk’ of death by not having the required medication, such as insulin, available and the necessity to use ‘expired, high risk’ drugs, which could result in reduced potency and possible death, often caused a dilemma in the individual. Willner et al., (2020) supported this in their study of Type 1 diabetic patients where patients stated that diabetics are dependent on insulin to live and if access to this medication is ‘threatened’ they would do anything to get the drug, including the use of denatured medication.

The data also suggested that if expiration dates were checked, it was an unconscious decision and action, unrelated to any fear of adverse health outcomes. Another determining factor in the consumption of expired medication, was the importance in which the prescribed medicines were to the individual’s health, for example if circumstances prevented access to life saving medications such as shortages, or if the health issue was severe enough to negatively impact the individual’s daily life such as a migraine.

Surprisingly, the action of checking medications for expiration became more of a conscious act for medications stored in the home and considered ‘old’ medicines. Interestingly, most of the participants had no concern over the use and risk of old and expired medications if the medicine was to be consumed by themselves. This absence of concern for risk increased dramatically if the medication was to be consumed by or administered to, a child or an elderly person and participants expressed that they would not medicate such persons with expired medicines, regardless of what type of medication it was, even ‘low risk’ ones.

At a personal level, there were differences in practices, beliefs and understandings of medications in general and of expiration dates. Things such as chronic health conditions, types of medications such as those identified as lifesaving or alternative (natural) and even liquid versus solid medicines, all contributed to personal health beliefs and influenced understandings. The data revealed that prior experience with adverse effects of medicines was predominantly blamed on the medications expiration despite other evident factors at play, such as incorrect storage. In general 'old' medicines were considered to be low risk as high end (risky) medicines were felt to be consumed within the required time frames after dispensing.

There was a distinct difference of opinion on a medications structure such as liquid versus solid. Half the participants were more concerned about risk of liquid medications than solid medications if expired. This risk increased exponentially if the liquid was stored outside of the required temperature indicated on the packaging. Interestingly although provided information gives suggestions for storage of medications, very few adhere to these regulations, preferring to place medications where it is most convenience to the patient themselves. This is supported by Hewson et al., (2013) who found little information to explain why people choose certain storage and placement areas, however there were common areas chosen such as the kitchen.

Expired Medication Information

An individual's health literacy was evident in the discourses. Medications were spoken of from a biomedical perspective and participants considered drugs from their chemical compounds, and their effectiveness or ineffectiveness despite participants being lay people (Sundar et al., 2012).

Kaufman & Novack (2003) argue that food date stamps are placed on products to protect society and many of the participants made sense of medication expiration dates by

applying the same societal considerations and processes they would to food quality, before and after expiration. The data also revealed that people are aware and affected by the vast amount of food wastage caused by the various dates used in food production to identify the date after which a food should not be consumed and are conscious of this same wastage happening with medications. This supports the research of Smith (2020) who identified that consumers were disposing of perfectly safe and edible products based on the individual's perception of what these dates mean. Previous research confirms the continuing increase of pharmaceutical production and public consumption has led to a staggering increase in expired medications having an impact on the environment and current global wastage (Azad et al., 2016), resulting from such things as over prescribing and inappropriate disposal methods (Alnahas et al., 2020). This excessive wastage led to the USA Food labelling act being legislated, however currently there is no evidence to support any such initiative being proposed for medications, despite the expectations of the participants revealed in the data.

Kleinman (2020) argued that personal experiences were not the only factor people used to make sense of medication expiry dates but culture, upbringing and social context are also significant. This was particularly relevant when asked about taking or using an expired medication, supported by the study results. For example, one participant's view that medicines are less effective after expiry was reinforced when her mother had a negative experience with an expired inhaler and another based her decisions on life lessons around medications, from information and practices learned from parents and trusted these beliefs over the information from the dispenser.

Social Understandings

There was compelling evidence in the data to highlight the varying wider social understandings of expiration dates i.e. power, control, wastage, and there was a lot more confusion here. The data revealed that participants had little trust in pharmaceutical

manufacturers and policymakers, believing that the only intention of such companies, was profit. The data also indicated that it was the belief that medical care providers were also financially motivated to prescribe certain drugs and in certain quantities. Interestingly although there was strong mistrust of the pharmaceutical industry, people initially placed unquestioning trust that legislators were doing what was best for society regarding reduction and minimisation of medication wastage and redistribution of perfectly effective medication to those unable to access medicines. .The data revealed that these views changed on further investigation of the go to market information and the disconnected actions behind this information, which is further covered later in the discussion.

Lastly, what led to high emotions, was political and regulatory ideas about expiration dates. Whilst Azad et al., (2016) found that continual increase in medicine production by pharmaceutical companies led to the staggering increase in expired medications and added to global wastage, Alnaha et al., (2020) felt that this was the result of many other factors such as misconception and misunderstanding of pharmaceutical expiration dates resulting in improper disposal practise and over prescribing of medications by primary care practitioners. However, many of the participants alluded to such practices as a 'marketing strategy' to sell more product and increase pharmaceutical profits.

It was revealed that there is a lack of standard medication guidelines regarding expired medications for patients to fully understand the use, return or disposal of unused or expired medicines. It was found that there was a substantial gap between governing documentation and the regular practices between an individual and their medications. Interestingly, the general public were highly motivated and altruistic to finding solutions to alter the current model of production, prescribing and wastage of perfectly good medicines.

Medications are understood to be drugs which assist in improving the health of the patient, however this study revealed that they are far more complex and affected by social

and psychological interactions. As Whyte et al., (2002) stated, these interactions live social lives with the individuals, which starts the moment patient's accept medicine into their lives. Medicines have value far beyond their chemical attributes becoming more semiotic as they become more valuable (van der Geest et al., 1996).

The data revealed that participants understood that medications could be both injurious and beneficial, however circumstance dictated whether they would cross the boundaries and pitfalls of expired medicines. The data highlighted that many patients did not trust pharmaceutical companies to have their best interests in mind when deciding on the life cycle of a medicine or its dangers and this led to people performing their own investigations and acting on their obtained results, even for high risk medications.

Medication Wastage

The Covid-19 pandemic created conspiracy theories between the public and pharmaceutical companies and this appears to have led to the continuance of the questioning and mistrust of pharmaceutical manufacturers. For example, policy insists that medication, unused or after expiration must be returned to an accepting outlet such as a community pharmacy, for recycling, expressing the dangers of such medication. However, two things emerged from the data regarding this. One was that during the pandemic certain medication was in short supply and during such time, it was not only accepted but encouraged to use expired medicines. This led to people asking if it can be done during a pandemic, why are they not continuing to do so. Secondly, it raised awareness that recycling is not recycling but a word used to mean disposal. Many participants admitted they had not considered this and had accepted that medications would be checked and redistributed to those in need and were angry that New Zealand was adding to global wastage and negative environmental impact when a beneficial alternative was obvious. Research supports this with claims that 'the world is consumer market and dictates it is cheaper to dump than repair' (Kas Govind (2021).

Currently New Zealand dumps over $40 million dollars in unused/expired medications into landfills each year (Scott, 2021). The data highlighted the possibility that expiration dates used by pharmaceutical companies, are a contributing factor to this wastage. New Zealand legislation also calls for people to return their unused or expired medications to a pharmacist for 'recycling'. Firstly, this is a good example of insufficient information when not all pharmacies accept returned medications, only community pharmacies and only some of these community pharmacies. Information on which pharmacies do so is not easily accessible or readily available to the public. Secondly, recycling in New Zealand is the end of a medications life cycle through disposal. The study revealed the unhappiness of the general public with this practice when there is evidence that many people are having to go without or share lifesaving medication due to shortage or unaffordability.

Over the past decade moves to recycle medications in the true sense has grown substantially with many countries implementing drug return programs such as NPTBP in the USA and NatRUM in Australia, however without a strong coalition between policy makers, pharmaceutical manufacturers and prescribers the programmes are not as successful as hoped. This further highlights the lack of detailed information, able to be understood by lay people around the 'why' and 'how' of medication recycling and the inability of legislators to ensure that unused or expired medications life cycles are perpetual.

Politics

This study revealed that there was little trust in government and big pharma with regards to current legislation and organisations to facilitate a true recycling and redistribution programme. It highlighted the concerns of the public that New Zealand had little interest in initiating such programmes which could benefit people and reduce negative global impact. It also revealed that the general public believe putting such programmes into action would require very little effort or money if handled correctly. This reiterated the participants views

that government decisions were influenced by pharmaceutical manufacturers and were encouraged not to introduce such programmes as this would negatively affect profits. The study also revealed strong neoliberal views on the way prescription medications should be treated by legislators and policymakers with a strong lean towards deregulation and extension of medication shelf lives.

Conclusion

This research revealed we can understand medication expiration dates as much more than random dates stamped onto medicines. The taken-for-granted aspects of medication were highlighted with the focus of this research, particularly how little we pay attention to the end of the medications life-cycle. Specifically, the age of the medication (new being something directly collected from the dispenser versus medication already in the home), the type of medication relevant to the person which is contextual), whether a medication is solid or liquid, if the medication is for the individual themselves or for children or older patients, and what underlying health the conditions the person has are all important factors in sense making of the date and the expired medication. These factors plus, the persons health and beliefs influence whether a person will consider the consumption of expired medication. Unexpected events sometimes meant that medication risks and possible adverse outcomes were ignored, such as during a medication shortage, financial restrictions or the inability to access new medicines. Storage, disposal and the potential for recycling medications were highlighted by varying and often strong views of the politics, globalisation, and power of drug companies, regulatory organisations, and funding of medications. Further research is needed to continue to unpack the nuances of medication understandings.

References

Acosta, A., Vanegas, E. P., Rovira, J., Godman, B., & Bochenek, T. (2019). Medicine Shortages: Gaps Between Countries and Global Perspectives. *Frontiers in Pharmacology*, *10*, 763. https://doi.org/10.3389/fphar.2019.00763

Adams, A. J., & Stolpe, S. F. (2016). Defining and Measuring Primary Medication Nonadherence: Development of a Quality Measure. *Journal of Managed Care and Speciality Pharmacy*, *22*(5), 516-523. https://doi.org/10.18553/jmcp.2016.22.5.516

Agarwal, P. (2020). Use of internet for practice of self medication- Are we heading towards an era of internet-pharmacy? *Medical Journal of Dr D Y Patil Vidyapeeth*, *14*. https://doi.org/10.4103/mjdrdypu.mjdrdypu_242_20

Ahuriri-Driscoll, A., B., V., H., M., H., M., M., & C., T., S (2008). *The future of rongoa Maori: wellbeing and sustainability. A summary.* https://ir.canterbury.ac.nz/handle/10092/5897

Ajana, B. (2017). Digital health and the biopolitics of the Quantified Self. *Sage Journals*, *3*. https://doi.org/10.1177/2055207616689509

Akatsu, H., & Kuffner, J. (1998). Medicine and the Internet. *West J Med*, *169*(5), 311-317.

Al-Arifi, M. N. (2021). Assessment of Knowledge, Attitudes, and Factors Influencing the Selection Student of Generic Medicine. *Frontiers in Public Health*, *9*, 767128.

Al-Ghanem, E. (2021). The Impact of Brand Equity of Global Pharmaceutical Companies on Prescriptions Decisions of Physicians in Jordan: The Moderating Role the Performance of Medical Representatives. *Research in World Economy*, *12*, 302. https://doi.org/10.5430/rwe.v12n2p302

Al-Shareef, F., El-Asrar, S. A., Al-Bakr, L., Al-Amro, M., Alqahtani, F., Aleanizy, F., & Al-Rashood, S. (2016). Investigating the disposal of expired and unused medication in Riyadh, Saudi Arabia: a cross-sectional study. *International Journal of Clinical Pharmacy 38*(4), 822-828. https://doi.org/10.1007/s11096-016-0287-4

Ali, S. A., Savera, A., & Suhail, N. (2016). Storage of medicines a review. *Journal of nursing*, *6*(1). https://www.researchgate.net/publication/325106135_Storage_of_medicines_a_review_P

Allemann, S. S., Nieuwlaat, R., Navarro, T., Haynes, B., Hersberger, K. E., & Arnet, I. (2017). Congruence between patient characteristics and interventions may partly explain medication adherence intervention effectiveness: an analysis of 190 randomized controlled trials from a Cochrane systematic review. *Journal of Clinical Epidemiology*, *91*, 70-79. https://doi.org/10.1016/j.jclinepi.2017.07.011

Almutairi, K. M. (2015). Culture and language differences as a barrier to provision of quality care by the health workforce in Saudi Arabia. *Saudi Medical Journal*, *36*(4), 425-431. https://doi.org/10.15537/smj.2015.4.10133

Alnahas, Yeboah, Fliedel, Abdin, & Alhareth. (2020). Expired Medication: Societal, Regulatory and Ethical Aspects of a Wasted Opportunity. *International Journal of Environmental Research & Public Health*, *17*(3). https://doi.org/ DOI: 10.3390/ijerph17030787

Amichai-Hamburger, Y., McKenna, K., & Samuel-Azran, T. (2008). E-empowerment: Empowerment by the Internet. *Computers in Human Behavior*, *24*, 1776-1789. https://doi.org/10.1016/j.chb.2008.02.002

Angell, M. (2004). Excess in the pharmaceutical industry. *Canadian Medical Association journal, 16(8), 963–964.*, *171*(12), 1451-1453. https://doi.org/ DOI: https://doi.org/10.1503/cmaj.1041594

Arafat, S. M. Y., Kar, S. K., Marthoenis, M., Sharma, P., Hoque Apu, E., & Kabir, R. (2020). Psychological underpinning of panic buying during pandemic (COVID-19). *Psychiatry Research*, *289*, 113061. https://doi.org/https://doi.org/10.1016/j.psychres.2020.113061

Aronson, J. K., & Green, A. R. (2020). Me-too pharmaceutical products: History, definitions, examples, and relevance to drug shortages and essential medicines lists. *British journal of clinical pharmacology*, *86*(11), 2114-2122. https://doi.org/10.1111/bcp.14327

Asher, M. I., Stewart, A. W., Clayton, T. O., Crane, J., Ellwood, P., Mackay, R., Mitchell, E. A., Moyes, C. D., Pattemore, P. K., & Pearce, N. (2008). Has the prevalence and severity of symptoms of asthma changed among children in New Zealand? ISAAC Phase Three. *The New Zealand Medical Journal 121* (1284), 52-63. https://pubmed.ncbi.nlm.nih.gov/18953387/

Azad, A. K., Hossain, M., Rahman, M., Robuiul, Abdullah, & Islam, K. (2016). Medication Wastage and its Impact on Environment: Evidence from Malaysia. *Pharmacologyonline*, *Vol 3*, 114-121. https://www.researchgate.net/publication/321965220_Medication_Wastage_and_its_Impact_on_Environment_Evidence_from_Malaysia

Bach, R. L., & Wenz, A. (2020). Studying health-related internet and mobile device use using web logs and smartphone records. *PLOS ONE*, *15*(6), e0234663. https://doi.org/10.1371/journal.pone.0234663

Baird, R. M., Crowden, C. A., O'Farrell, S. M., & Shooter, R. A. (1979). Microbial contamination of pharmaceutical products in the home. *Journal of Hygiene*, *83*(2), 277-283. https://doi.org/10.1017/S0022172400026073

Banning, M. (2006). Medication errors: professional issues and concerns. *Nursing Older People*, *18*(3), 27-32. https://doi.org/10.7748/nop2006.04.18.3.27.c2419

Barker, J., Martino, R., Reichardt, B., Hickey, E. J., & Ralph-Edwards, A. (2009). Incidence and impact of dysphagia in patients receiving prolonged endotracheal intubation after cardiac surgery. *Canadian Journal of Surgery*, *52*(2), 119-124. https://pubmed.ncbi.nlm.nih.gov/19399206/

Barnett, K., Mercer, S. W., Norbury, M., Watt, G., Wyke, S., & Guthrie, B. (2012). Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *The Lancet*. https://doi.org/https://doi.org/10.1016/S0140-6736(12)60240-2

Basile, V. (2019). Building a Strong Brand Equity in Pharmaceutical Industry: the Case of Over-the-Counter Drugs in Italian Country. *International Journal of Customer Relationship Marketing and Management*, *10*, 1-20. https://doi.org/10.4018/IJCRMM.2019070101

Battineni, G., Baldoni, S., Chintalapudi, N., Sagaro, G. G., Pallotta, G., Nittari, G., & Amenta, F. (2020). Factors affecting the quality and reliability of online health information. *Digital Health 6*. https://doi.org/https://doi.org/10.1177/2055207620948996

Beasley, L., Grace, S., & Horstmanshof, L. (2021). Assessing individual readiness for change in healthcare: a review of measurement scales. *Journal of Health Organization and Management*. https://doi.org/DOI:10.1108/JHOM-10-2020-0414

Benigeri, M., & Pluye, P. (2003). Shortcomings of health information on the Internet. *Health Promotion International*, *18*(4), 381-386. https://doi.org/10.1093/heapro/dag409

Benson, T., & Grieve, G. (2021). *Principles of Health Interoperability* (3rd ed.). SpringerLink.

Beyene, K. A., Sheridan, J., & Aspden, T. (2014). Prescription Medication Sharing: A Systematic Review of the Literature. *American Journal of Public Health*, *104*(4), e15-e26. https://doi.org/10.2105/ajph.2013.301823

Bisiada, M. (2021). Discursive structures and power relations in Covid-19 knowledge production. *Humanities and Social Sciences Communications*, *8*(1), 248. https://doi.org/10.1057/s41599-021-00935-2

Bitsko, R. H., Claussen, A. H., Lichstein, J., Black, L. I., Jones, S. E., Danielson, M. L., Hoenig, J. M., Jack, S. P. D., Brody, D. J., Gyawali, S., Maenner, M. J., Warner, M., Holland, K. M., Perou, R., Crosby, A. E., Blumberg, S. J., Avenevoli, S., Kaminsk, J. W., & Ghandour, R. M. (2022). Mental Health Surveillance Among Children — United States, 2013–2019. *National Library of Medicine*. https://doi.org/DOI: 10.15585/mmwr.su7102a1

Boulos, M. N., Brewer, A. C., Karimkhani, C., Buller, D. B., & Dellavalle, R. P. (2014). Mobile medical and health apps: state of the art, concerns, regulatory control and certification. *Centers for Disease Control and Prevention*, *5*(3), 229. https://doi.org/DOI: http://dx.doi.org/10.15585/mmwr.su7102a1

Bourgeois, F. T., Murthy, S., & Mandl, K. D. (2010). Outcome Reporting Among Drug Trials Registered in ClinicalTrials.gov. *Annals of Internal Medicine*, *153*(3), 158-166. https://doi.org/10.7326/0003-4819-153-3-201008030-00006 %m 20679560

Bourgeois, F. T. B., C., L., Ayers, J. W., Brownstein, J. S., Bronstein, A. C., & Ewald, M. B. (2013). Adult Prescription Drug Use and Pediatric Medication Exposures and Poisonings. *Pediatrics*, *132*(1), 18-27. https://doi.org/10.1542/peds.2012-2978

Bowden, N., Gibb, S., Thabrew, H., Audas, R., Camp, J., Taylor, B., & Hetrick, S. (2019). IDI trends in antidepressant dispensing to New Zealand children and young people between 2007/08 and 2015/16. *New Zealand Medical Journal*, *132*(1505). https://journal.nzma.org.nz/journal-articles/idi-trends-in-antidepressant-dispensing-to-new-zealand-children-and-young-people-between-2007-08-and-2015-16

Bowden, N., Gibb, S., Thabrew, H., Audas, R., Camp, J., Taylor, B., & Hetrick, S. (2019). IDI trends in antidepressant dispensing to New Zealand children and young people between 2007/08 and 2015/16. *132*(1505). https://journal.nzma.org.nz/journal-articles/idi-trends-in-antidepressant-dispensing-to-new-zealand-children-and-young-people-between-2007-08-and-2015-16

Boyd, K. (2021). Beyond politics: additional factors underlying skepticism of a COVID-19 vaccine. *History & Philosophy of the Life Sciences*, *43*(1), 12. https://doi.org/10.1007/s40656-021-00369-8

Boztepe, H., Özdemir, H., Karababa, Ç., & Yıldız, Ö. (2016). Administration of oral medication by parents at home. *Journal of Clinical Nursing*, *25*. https://doi.org/ https://doi.org/10.1111/jocn.13460

BPACNz. (2021b). *National Report: Overview of national dispensing during 2020*. https://bpac.org.nz/report/2020/national-dispensing.aspx#fig2

Braun, V., & Clarke, V. (2006). *Thematic Analysis*. https://www.thematicanalysis.net/

Brown, M. T., & Bussell, J. K. (2011). Medication adherence: WHO cares? *Mayo Clinic Proceedings*, *86*(4), 304-314. https://doi.org/DOI: 10.4065/mcp.2010.0575

Burghardt, L. C., Ayers, J. W., Brownstein, J. S., Bronstein, A. C., Ewald, M. B., & Bourgeois, F. T. (2013). Adult Prescription Drug Use and Pediatric Medication Exposures and Poisonings. *Pediatrics*, *132*(1), 18-27. https://doi.org/10.1542/peds.2012-2978

Calnan, M. W., & Sanford, E. (2004). Public trust in health care: the system or the doctor? *Qual Saf Health Care*, *13*(2), 92-97. https://doi.org/10.1136/qshc.2003.009001

Cantrell, L., Suchard, J., & Gerona, R. (2013). Comment Regarding the Stability of Active Ingredients in Long-Expired Prescription Medications—Reply. *Canadian Pharmacists Journal*, *173*(11), 1034-1035. https://doi.org/DOI: 10.1177/1715163521990408

Capron, A. M. (1984). An ethical obligation to ensure access to new medical technologies? *Journal of Health Care Technology*, *1*(2), 103-120. https://pubmed.ncbi.nlm.nih.gov/10271138/

Chalker, J. (2012). Managing for rational medicine use. *Management Sciences for Health*. https://msh.org/wp-content/uploads/2013/04/mds3-ch27-rationaluse-mar2012.pdf

Chaudhary, N., & Murata, L. (2015). Can tech be used for social good? *Intersect: The Stanford Journal of Science, Technology, and Society*, *9*(1). https://scholarworks.bgsu.edu/cgi/viewcontent.cgi?article=1643&context=honorsprojects

Chisholm-Burns, M. A., & Spivey, C. A. (2012). The 'cost' of medication nonadherence: consequences we cannot afford to accept. *Journal of the Amercan Pharmacists Association (2003)*, *52*(6), 823-826. https://doi.org/DOI:https://doi.org/10.1331/JAPhA.2012.11088

Choo, E. K., & Rajkumar, S. V. (2020). Medication Shortages During the COVID-19 Crisis: What We Must Do. *Mayo Clinic Proceedings*, *95*(6), 1112-1115. https://doi.org/DOI:https://doi.org/10.1016/j.mayocp.2020.04.001

Cialdini, R. B., Wosinska, W., Barrett, D. W., Butner, J., & Gornik-Durose, M. (1999). Compliance with a request in two cultures: The differential influence of social proof and commitment/consistency on collectivists and individualists. *Personality and Social*

Psychology Bulletin, *25*(10), 1242-1253. https://doi.org/https://doi.org/10.1177/0146167299258006

Coggon, J., & Miola, J. (2011). Autonomy, Liberty and Medical Decision-making. *Cambridge Law Journal 70*(3), 523-547. https://doi.org/10.1017/s0008197311000845

Cohen, R. A., & Adams, P. F. (2011). Use of the internet for health information: United States, 2009. *Nataional Library of Medicine*(66), 1-8. https://pubmed.ncbi.nlm.nih.gov/22142942/

Colgan, S., Faasse, K., Martin, L. R., Stephens, M. H., Grey, A., & Petrie, K. J. (2015). Perceptions of generic medication in the general population, doctors and pharmacists: a systematic review. *Pharmacology & Therapeutics*, *5*(12). https://doi.org/http://dx.doi.org/10.1136/bmjopen-2015-008915

Conn, R., Fox, A., Carrington, A., Dornan, T., & Lloyd, M. (2021). Prescribing errors in children: why they happen and how to prevent them. *The Pharmaceutical Journal*. https://pharmaceutical-journal.com/article/ld/prescribing-errors-in-children-why-they-happen-and-how-to-prevent-them

Coveney, C., Williams, S. J., & Gabe, J. (2019). Medicalisation, pharmaceuticalisation, or both? Exploring the medical management of sleeplessness as insomnia. *Sociolgy of Health and Illness*, *41*(2), 266-284. https://doi.org/10.1111/1467-9566.12820

Crawford, R. (1980). Healthism and the medicalization of everyday life. *International Journal of Social Determinants of Health and Health Services*, *10*(3), 365-388. https://doi.org/DOI: 10.2190/3H2H-3XJN-3KAY-G9NY

Cunningham, T. V. (2017). Health, Disease, and the Basic Aims of Medicine. In M. P. Adams, Z. Biener, U. Feest, & J. A. Sullivan (Eds.), *Eppur si muove: Doing History and Philosophy of Science with Peter Machamer: A Collection of Essays in Honor of Peter Machamer* (pp. 141-162). Springer International Publishing. https://doi.org/10.1007/978-3-319-52768-0_10

Cutler, R. L., Fernandez-Llimos, F., Frommer, M., Benrimoj, C., & Garcia-Cardenas, V. (2018). Economic impact of medication non-adherence by disease groups: a systematic review. *British Medical Journal - open*, *8*(1). https://doi.org/DOI: 10.1136/bmjopen-2017-016982

D'Souz, S., Bowden, N., Gibb, S., Shackleton, N., Audas, R., Hetrick, S., Taylor, B., & Milne, B. (2020). Medication dispensing for attention-deficit/hyperactivity disorder to New Zealand youth. *New Zealand Medical Association*, *133*(1522). www.nzma.org.nz/journal

Darling, J. C. (2010). Management of nocturnal enuresis. *Trends in Urology, Gynaecology & Sexual Health*, *15*(3), 18-22. https://doi.org/https://doi.org/10.1002/tre.153

Dawood, O. T., Hassali, M. A., & Saleem, F. (2016). A qualitative study exploring medicines use pattern and practice among general public in Malaysia. *Pharmacy Practice (Granada)*, *14*(2), 740. https://doi.org/10.18549/PharmPract.2016.02.740

De Winter, S., Vanbrabant, P., Vi, N. T., Deng, X., Spriet, I., Van Schepdael, A., & Gillet, J. B. (2013). Impact of temperature exposure on stability of drugs in a real-world out-of-hospital setting. *Annals of Emergency Medicine: An International Journal*, *62*(4), 380-387.e381. https://doi.org/https://www.pharmacypractice.org/index.php/pp/article/view/740

Deer, B. (2011). How the case against the MMR vaccine was fixed. *British Medical Journal* https://doi.org/doi: https://doi.org/10.1136/bmj.c5347

Desai, R. J., Sarpatwari, A., Dejene, S., Khan, N. F., Lii, J., Rogers, J. R., Dutcher, S. K., Raofi, S., Bohn, J., Connolly, J. G., Fischer, M. A., Kesselheim, A. S., & Gagne, J. J. (2019). Comparative effectiveness of generic and brand-name medication use: A database study of US health insurance claims. *PLOS Medicine*, *16*(3). https://doi.org/https://doi.org/10.1371/journal.pmed.1002763

Desantis, A. D., & Hane, A. C. (2010). "Adderall is Definitely Not a Drug": Justifications for the Illegal Use of ADHD Stimulants. *Medicinal Stimulant Misuse: Justifications*, *45*(1-2), 31-46. https://doi.org/https://doi.org/10.3109/10826080902858334

Diallo, S., Herencia, H., Padilla, J., & Tolk, A. (2011). *Understanding interoperability*.

Diaz, J. A., Griffith, R. A., Ng, J. J., Reinert, S. E., Friedmann, P. D., & Moulton, A. W. (2002). Patients' Use of the Internet for Medical Information. *Journal of General Internal Medicine*, *17*(3), 180-185. https://doi.org/https://doi.org/10.1046/j.1525-1497.2002.10603.x

Dodgson, J. E. (2019). Reflexivity in Qualitative Research. *Journal of Human Lactation*, *35*(2), 220-222. https://doi.org/DOI: 10.1177/0890334419830990

Donaldson, M., Goodchild, J. H., & Epstein, J. B. (2015). Sugar content, cariogenicity, and dental concerns with commonly used medications. *Journal of the American Dental Association*, *146*(2), 129-133. https://doi.org/https://jada.ada.org/article/S0002-8177(14)00028-2/fulltext

du Plessis, D., Sake, J. K., Halling, K., Morgan, J., Georgieva, A., & Bertelsen, N. (2017). Patient Centricity and Pharmaceutical Companies: Is It Feasible? *Therapeutic Innovation & Regulatory Science*, *51*(4), 460-467. https://doi.org/10.1177/2168479017696268

Dunn, C. J., Plosker, G. L., Keating, G. M., McKeage, K., & Scott, L. J. (2003). Insulin glargine: an updated review of its use in the management of diabetes mellitus. *SpringerLink*, *63*(16), 1743-1778. https://doi.org/10.2165/00003495-200363160-00007

Dunne, S. S., & Dunne, C. P. (2015). What do people really think of generic medicines? A systematic review and critical appraisal of literature on stakeholder perceptions of generic drugs. *BMC Medicine*, *13*(1), 173. https://doi.org/https://doi.org/10.1186/s12916-015-0415-3

Durward, C., & Thou, T. (1997). Dental caries and sugar-containing liquid medicines for children in New Zealand. *The New Zealand dental journal*, *93*(414), 124-129. http://europepmc.org/abstract/MED/9470445

Easthall, C. (2019). Medication Nonadherence as a Complex Health Behavior: There Is More to It Than Just Missed Doses. *Journal of the American Geriatrics Society*, *67*. https://doi.org/10.1111/jgs.16143

Eccles, R., & Mallefet, P. (2017). Soothing Properties of Glycerol in Cough Syrups for Acute Cough Due to Common Cold. *Pharmacy*, *5*, 4. https://doi.org/10.3390/pharmacy5010004

Edelstein, P. (2015). Don't Take Your Medications as Prescribed? You're Not Alone: Understand & address your reasons for not always taking your medications. https://www.psychologytoday.com/us/blog/patient-power/201501/dont-take-your-medications-prescribed-you-re-not-alone

Elliott, R. (2009). Non-adherence to medicines: Not solved but solvable. *Journal of Health Services Research & Policy*, *14*(1), 58-61. https://doi.org/10.1258/jhsrp.2008.008088

Entradas, M. (2015). Science and the public: The public understanding of science and its measurements. *Portuguese Journal of Social Science*, *14*. https://doi.org/10.1386/pjss.14.1.71_1

Fairclough, N. (2003). *Analysing Discourse Textual analysis for social research*. Routledge

Fife, J. (2020). Pharmacy Council welcomes lockdown rule to limit drug access, stresses there's 'absolutely not' a shortage of medicine. *NZ Herald*. https://www.newshub.co.nz/home/new-zealand/2020/03/pharmacy-council-welcomes-lockdown-rule-to-limit-drug-access-stresses-there-s-absolutely-not-shortage-of-medicine.html

Finch, D., Marshall, L., Briggs, A., & Cameron, G. (2020). Improving the nation's health: The future of the public health system in England. *The Health Foundation UK*. https://www.health.org.uk/publications/reports/improving-the-nations-health

Floersch, J., Longhofer, J. L., Kranke, D., & Townsend, L. (2010). Integrating thematic, grounded theory and narrative analysis: A case study of adolescent psychotropic treatment. *Qualitative Social Work: Research and Practice*, *9*(3), 407-425. https://doi.org/https://doi.org/10.1177/1473325010362330

Forster, M. N. (2007). Hermeneutics.

Gebremariam, E. T., Gebregeorgise, D. T., & Fenta, T. G. (2019). Factors contributing to medicines wastage in public health facilities of South West Shoa Zone, Oromia Regional State, Ethiopia:

a qualitative study. *Journal of Pharmaceutical Policy and Practice*, *12*(1), 29. https://doi.org/10.1186/s40545-019-0192-z

Gikonyo, D., Gikonyo, A., Luvayo, D., & Ponoth, P. (2019). Drug expiry debate: the myth and the reality. *African health sciences*, *19*, 2737-2739. https://doi.org/10.4314/ahs.v19i3.49

Giugliano, D., Torella, R., Siniscalchi, N., Improta, L., & D'Onofrio, F. (1978). The effect of acetylsalicylic acid on insulin response to glucose and arginine in normal man. *Diabetologia*, *14*(6), 359-362. https://doi.org/10.1007/bf01228129

Giustini, D., Ali, S. M., Fraser, M., & Kamel Boulos, M. N. (2018). Effective uses of social media in public health and medicine: a systematic review of systematic reviews. *Online Journal of Public Health Informatics*, *10*(2). https://doi.org/DOI: https://doi.org/10.5210/ojphi.v10i2.8270

Godeliver Anatory Kagashe, F. B. M., Deus Buma. (2014). *Medicines Wastage at a Tertiary Hospital in Dar Es Salaam Tanzania* (Vol. Volume: 4). Issue: 6. https://japsonline.com/bib_files/abstract.php?article_id=japs1272

Gold, D. T., & McClung, B. (2006). Approaches to patient education: emphasizing the long-term value of compliance and persistence. *The American Journal of Medicine*, *119*(4 Suppl 1), S32-37. https://doi.org/https://www.amjmed.com/article/S0002-9343(05)01201-5/fulltext

Goldsmith, L. J., Kolhatkar, A., Popowich, D., Holbrook, A. M., Morgan, S. G., & Law, M. R. (2017). Understanding the patient experience of cost-related non-adherence to prescription medications through typology development and application. *Social Science & Medicine*, *194*, 51-59. https://doi.org/https://doi.org/10.1016/j.socscimed.2017.10.007

Gould, E., & Mitty, E. (2010). Medication adherence is a partnership, medication compliance is not. *Geriatric Nursing*, *31*(4), 290-298.

Graupner, L., Frost, S., Weinman, J., Wright, S. M., Hankins, M., & Horne, R. (2004). Medicine in a multi-cultural society: the effect of cultural background on beliefs about medications. *Soc Sci Med*, *59*(6), 1307-1313. https://doi.org/10.1016/j.socscimed.2004.01.009

Greenfield, B. H., & Jensen, G. M. (2010). Understanding the lived experiences of patients: application of a phenomenological approach to ethics. *Physical Therapy*, *90*(8), 1185-1197.

Greenhalgh, T., & Wessely, S. (2004). 'Health for me': a sociocultural analysis of healthism in the middle classes. *British Medical Bulletin*, *69*(1), 197-213. https://doi.org/10.1093/bmb/ldh013

Guillemin, M., & Gillam, L. (2004). Ethics, reflexivity, and "ethically important moments" in research. *Qualitative inquiry*, *10*(2), 261-280. https://doi.org/DOI:10.1177/1077800403262360

Hale, K. (2021). Benefits and Challenges of Social Media in Health Care. *Critical Care Nursing Quarterly*, *44*(3), 309-315. https://doi.org/DOI: 10.1097/CNQ.0000000000000366

Hall-Phillips, A., & Shah, P. (2017). Unclarity confusion and expiration date labels in the United States: A consumer perspective. *Journal of Retailing and Consumer Services*, *35*, 118-126. https://doi.org/https://doi.org/10.1016/j.jretconser.2016.12.007

Hanchak, N. A., Patel, M. B., Berlin, J. A., & Strom, B. L. (1996). Patient misunderstanding of dosing instructions. *Journal of General Internal Medicine*, *11*, 325-328. https://doi.org/DOI: 10.1007/BF02600041

hc-uk. (2022). *Motivating Staff to Change Behaviour to Improve Patient Safety*. Healthcare Conferences UK. https://www.healthcareconferencesuk.co.uk/virtual-online-courses/motivating-staff

Hess, L. M., Cui, Z. L., Li, X. I., Oton, A. B., Shortenhaus, S., & Watson, I. A. (2018). Drug wastage and costs to the healthcare system in the care of patients with non-small cell lung cancer in the United States. *J Med Econ*, *21*(8), 755-761. https://doi.org/10.1080/13696998.2018.1467918

Hewson, C., Shen, C., Strachan, C., & Norris, P. (2013). Personal medicines storage in New Zealand. *Journal of primary health care*, *5*, 146-150. https://doi.org/10.1071/HC13146

Hodgetts, D., Nikora, L. W., & Rua, M. (2011). Māori Men and the Indirect Procurement and Sharing of Prescription Medications. *AlterNative: An International Journal of Indigenous Peoples*, *7*(2), 152-162. https://doi.org/10.1177/117718011100700207

Horne, R., Chapman, S. C. E., Parham, R., Freemantle, N., Forbes, A., & Cooper, V. (2013). Understanding Patients' Adherence-Related Beliefs about Medicines Prescribed for Long-Term Conditions: A Meta-Analytic Review of the Necessity-Concerns Framework. *PLOS ONE*, *8*(12), e80633. https://doi.org/10.1371/journal.pone.0080633

Horne, R., Graupner, L., Frost, S., Weinman, J., Wright, S. M., & Hankins, M. (2004). Medicine in a multi-cultural society: the effect of cultural background on beliefs about medications. *Soc Sci Med*, *59*(6), 1307-1313. https://doi.org/10.1016/j.socscimed.2004.01.009

Housheh, S. (2017). *Stability of drugs and medicines Oxidation*.

Hsu, M. Y., & McCormack, B. (2010). The experience of applying a narrative research approach with older people. *Journal of Nursing Research*, *18*(4), 249-257. https://doi.org/10.1097/JNR.0b013e3181fc669e

Hughes, C. M. (2004). Medication Non-Adherence in the Elderly. *Drugs & Aging*, *21*(12), 793-811. https://doi.org/10.2165/00002512-200421120-00004

Hui, S. (2022). What Is Healthism, and Should It Be Avoided?

Hwu, Y. J. (2020). The Impact of Chronic Illness on Patients. *Rehabilitation Nursing: the official journal of the Association of Rehabilitation Nurses*, *45*(4), 180-184. https://doi.org/10.1097/rnj.0000000000000271

Iglehart, J. K. (1994). The role of the media in reporting and shaping public expectations. *Jourjnal of the Royal Society of Medicine*, *87*(Suppl 22), 15. https://pubmed.ncbi.nlm.nih.gov/20894951/

Iserson, K. V. (2021). Should We Use Expired Drugs When Necessary? *The Journal of Emergency Medicine*, *60*(5), 669-673. https://doi.org/https://doi.org/10.1016/j.jemermed.2021.02.002

Jackson, T. H., Bentley, J. P., McCaffrey, D. J., 3rd, Pace, P., Holmes, E., & West-Strum, D. (2014). Store and prescription characteristics associated with primary medication nonadherence. *Journal of Managed Care and Speciality Pharmmacy*, *20*(8), 824-832. https://doi.org/10.18553/jmcp.2014.20.8.824

Jafarzadeh, A., Mahboub-ahari, A., Naja, M., & Youse, M. (2020). *Medicine Storage, Wastage and Associated Determinants Among Urban Households: A Systematic Review of Household Surveys*. https://doi.org/10.21203/rs.3.rs-71586/v1

Jamkhande, P. G., Ghule, N. W., Bamer, A. H., & Kalaskar, M. G. (2019). Metal nanoparticles synthesis: An overview on methods of preparation, advantages and disadvantages, and applications. *Journal of Drug Delivery Science and Tecnhnology*, *53*, 101174. https://doi.org/https://doi.org/10.1016/j.jddst.2019.101174

Jansen, E. M., van de Hei, S. J., Dierick, B. J. H., Kerstjens, H. A. M., Kocks, J. W. H., & van Boven, J. F. M. (2021). Global burden of medication non-adherence in chronic obstructive pulmonary disease (COPD) and asthma: a narrative review of the clinical and economic case for smart inhalers. *Journal of Thoracic Disease*, *13*(6), 3846-3864. https://doi.org/doi: 10.21037/jtd-20-2360

Johnson, B. A. (2011). Addiction medicine. *Science and Practice. Springer.-2011*.

Kamboj, S., Kumar, P., Cai, X., & Stallworth, W. (1999). Cost of medications for elderly in a nursing home. *The Journal of the Louisiana State Medical Society: official organ of the Louisiana State Medical Society*, *151*(9), 470-472. https://pubmed.ncbi.nlm.nih.gov/11284148/

Karch, A. M. (2008). Waste not? *AJN The American Journal of Nursing*, *108*(7), 86-87. https://doi.org/DOI/10.1097/01.NAJ.0000325822.00252.5c

Karnieli-Miller, O., Strier, R., & Pessach, L. (2008). Power Relations in Qualitative Research. *Qualitative Health Research*, *19*(2), 279-289. https://doi.org/10.1177/1049732308329306

Kasamo, S., Matsumoto, S., Kawasaki, Y., Inoue, H., & Tasaki, Y. (2021). Changes in prescribing trends and initial pharmacotherapy of children with nocturnal enuresis in Japan: a large-scale medical claims database analysis. *World Journal of Urology*, *39*(9), 3517-3524. https://doi.org/10.1007/s00345-021-03664-y

Kaufman, B., & Novack, G. D. (2003). Compliance Issues in Manufacturing of Drugs. *The Ocular Surface*, *1*(2), 80-85. https://doi.org/https://doi.org/10.1016/S1542-0124(12)70131-3

Kennedy, B. M., Rehman, M., Johnson, W. D., Magee, M. B., Leonard, R., & Katzmarzyk, P. T. (2017). Healthcare Providers versus Patients' Understanding of Health Beliefs and Values. *Patient Experience Journal*, *4*(3), 29-37. https://pubmed.ncbi.nlm.nih.gov/29308429/

Kim, J., & De Jesus, O. (2022). *Medication Routes of Administration*. Stat Pearls Publishing. https://pubmed.ncbi.nlm.nih.gov/33760436/

Kim, J., & Parish, A. L. (2017). Polypharmacy and Medication Management in Older Adults. *Nursing Clinics of North America*, *52*(3), 457-468. https://doi.org/https://doi.org/10.1016/j.cnur.2017.04.007

Kiyingi, K., & Lauwo, J. (1993). Drugs in the home: danger and waste. *World health forum 14*(4), 381-384. https://pubmed.ncbi.nlm.nih.gov/8185788/

Kongar, E., Haznedaroglu, E., Abdelghany, O., & Bahtiyar, M. O. (2015). A novel IT infrastructure for reverse logistics operations of end-of-life pharmaceutical products. *Information Technology and Management*, *16*(1), 51-65. https://doi.org/10.1007/s10799-014-0195-z

Korp, P. (2006). Health on the Internet: Implications for health promotion. *Health education research*, *21*, 78-86. https://doi.org/10.1093/her/cyh043

Laaser, U., & Kovacic, L. (2007). *Health Promotion and Disease Prevention*. https://www.researchgate.net/publication/235246304_Health_Promotion_and_Disease_Prevention

Latour, B., & Woolgar, S. (1986). *Laboratory life: The construction of scientific facts*. Princeton University Press. https://press.princeton.edu/books/paperback/9780691028323/laboratory-life

Law, R., & Chalmers, C. (1976). Medicines And Elderly People: A General Practice Survey. *The British Medical Journal*, *1*(6009), 565-568. http://www.jstor.org/stable/20408930

Leask, J., Hooker, C., & King, C. (2010). Media coverage of health issues and how to work more effectively with journalists: a qualitative study. *BMC Public Health*, *10*(1), 535. https://doi.org/10.1186/1471-2458-10-535

Lee, H.-H., & Lin, S.-H. (2020). Effects of COVID-19 Prevention Measures on Other Common Infections, Taiwan. *Emerging Infectious Disease journal*, *26*(10), 2509. https://doi.org/10.3201/eid2610.203193

Lehane, E., & McCarthy, G. (2007). Intentional and unintentional medication non-adherence: a comprehensive framework for clinical research and practice? A discussion paper. *International Journal of Nursing Studies*, *44*(8), 1468-1477. https://doi.org/10.1016/j.ijnurstu.2006.07.010

Leung, J., Chung, J. Y. C., Tisdale, C., Chiu, V., Lim, C. C. W., & Chan, G. (2021). Anxiety and Panic Buying Behaviour during COVID-19 Pandemic—A Qualitative Analysis of Toilet Paper Hoarding Contents on Twitter. *International Journal of Environmental Research and Public Health*, *18*(3), 1127. https://www.mdpi.com/1660-4601/18/3/1127

Levy, J. A., & Strombeck, R. (2002). Health Benefits and Risks of the Internet. *Journal of Medical Systems*, *26*(6), 495-510. https://doi.org/10.1023/A:1020288508362

Liebert, R., & Gavey, N. (2009). "There are always two sides to these things": Managing the dilemma of serious adverse effects from SSRIs. *Social Science & Medicine*, *68*(10), 1882-1891. https://doi.org/https://doi.org/10.1016/j.socscimed.2009.02.047

Linnard-Palmer, L., & Kools, S. (2004). Parents' refusal of medical treatment based on religious and/or cultural beliefs: the law, ethical principles, and clinical implications. *Journal of pediatric nursing*, *19*(5), 351-356. https://doi.org/10.1016/j.pedn.2004.05.014

Liu, F., Ranmal, S., Batchelor, H. K., Orlu-Gul, M., Ernest, T. B., Thomas, I. W., Flanagan, T., & Tuleu, C. (2014). Patient-centered pharmaceutical design to improve acceptability of medicines: similarities and differences in paediatric and geriatric populations. *Drugs*, *74*(16), 1871-1889.

Ljubica, C. (2021). 38 Fundamental Pharmaceutical Statistics and Facts for 2021. https://supplements101.net/pharmaceutical-statistics/

Lu, Y., Wu, Y., Liu, J., Li, J., & Zhang, P. (2017). Understanding Health Care Social Media Use From Different Stakeholder Perspectives: A Content Analysis of an Online Health Community. *Journal of Medical Internet Research*, *19*(4). https://doi.org/ DOI: 10.2196/jmir.7087

Mackey, T. K., & Liang, B. A. (2011). The global counterfeit drug trade: patient safety and public health risks. *Journal of Pharmaceutical Services*, *100*(11), 4571-4579. https://doi.org/https://www.jmir.org/2017/4/e109/

MacroTrends. (2022). *New Zealand GDP 1960-2022*. https://www.macrotrends.net/countries/NZL/new-zealand/gdp-gross-domestic-product#:~:text=1%20New%20Zealand%20gdp%20for%202021%20was%20%24249.99B%2C,2018%20was%20%24211.95B%2C%20a%202.58%25%20increase%20from%202017.

Mair, A., Fernandez-Llimos, F., Alonso, A., Harrison, C., Hurding, S., Kempen, T., Kinnear, M., Michael, N., McIntosh, J., & Wilson, M. (2017). *Polypharmacy Management by 2030: a patient safety challeng* (978-989-20-7674-4). https://www.napier.ac.uk/research-and-innovation/research-search/outputs/polypharmacy-management-by-2030-a-patient-safety-challenge

Makki, M., Hassali, M. A., Awaisu, A., & Hashmi, F. (2019). The Prevalence of Unused Medications in Homes. *Pharmacy (Basel)*, *7*(2). https://doi.org/10.3390/pharmacy7020061

Manen, M. v. (1997). From Meaning to Method. *Qualitative Health Research*, *7*(3), 345-369. https://doi.org/10.1177/104973239700700303

Manzoli, L., Flacco, M. E., Boccia, S., D'Andrea, E., Panic, N., Marzuillo, C., Siliquini, R., Ricciardi, W., Villari, P., & Ioannidis, J. P. A. (2016). Generic versus brand-name drugs used in cardiovascular diseases. *European Journal of Epidemiology*, *31*(4), 351-368. https://doi.org/10.1007/s10654-015-0104-8

Marwa, K. J., McHaro, G., Mwita, S., Katabalo, D., Ruganuza, D., & Kapesa, A. (2021). Disposal practices of expired and unused medications among households in Mwanza, Tanzania. *PLOS ONE*, *16*(2), e0246418. https://doi.org/10.1371/journal.pone.0246418

Mason, H. D. (2012). *Indigenous health: New Zealand experience*. https://www.mja.com.au/journal/2012/197/1/indigenous-health-new-zealand-experience

Matsui, D. (2007). Current Issues in Pediatric Medication Adherence. *SpringerLink: Paediatric Drugs*, *9*(5), 283-288. https://doi.org/10.2165/00148581-200709050-00001

McCarty, E. B., & Chao, T. N. (2021). Dysphagia and Swallowing Disorders. *Medical Clinics of North America*, *105*(5), 939-954. https://doi.org/https://doi.org/10.1016/j.mcna.2021.05.013

McConnell-Henry, T., Chapman, Y., & Francis, K. (2011). Member checking and Heideggerian phenomenology: A redundant component. *Nurse researcher*, *18*(2). https://doi.org/https://pubmed.ncbi.nlm.nih.gov/21319482/

McNaughton-Cassill, M. (2020). Unmasking the Mask Controversy. *Psychology Today*. https://www.psychologytoday.com/us/blog/mental-health-matters/202007/unmasking-the-mask-controversy

McQuaid, E. L., & Landier, W. (2018). Cultural Issues in Medication Adherence: Disparities and Directions. *J Gen Intern Med*, *33*(2), 200-206. https://doi.org/10.1007/s11606-017-4199-3

McRae, D., Allman, M., & James, D. (2016). The redistribution of medicines: could it become a reality? *International Journal of Pharmacy Practice*, *24*(6), 411-418. https://doi.org/10.1111/ijpp.12275

Mendel, A., Bernatsky, S., Thorne, J. C., Lacaille, D., Johnson, S. R., & Vinet, É. (2021). Hydroxychloroquine shortages during the COVID-19 pandemic. *Social Science & Medicine*, *80*(3), e31. https://doi.org/https://doi.org/10.1016/j.socscimed.2004.01.009

Meriwani, O. (2022). GIF Science: The Crisis of Science Simplification on Social Media. *46*(3). https://skepticalinquirer.org/2022/05/gif-science-the-crisis-of-science-simplification-on-social-media/

Metcalfe, S., Laking, G., & Arnold, J. (2013). Variation in the use of medicines by ethnicity during 2006/07 in New Zealand: a preliminary analysis. *The New Zealand Medical Journal 136*(1569). http://journal.nzma.org.nz/journal/126-1384/5869/

Miron, A., & Brehm, J. (2006). Reactance Theory - 40 Years Later. *Zeitschrift Fur Sozialpsychologie - Z SOZPSYCHOL*, *37*, 9-18. https://doi.org/10.1024/0044-3514.37.1.9

Misra, R., & Kaster, E. C. (2012). Health Beliefs. In S. Loue & M. Sajatovic (Eds.), *Encyclopedia of Immigrant Health* (pp. 766-768). Springer New York. https://doi.org/10.1007/978-1-4419-5659-0_332

Mitchell, A., & Selmes, T. (2007). Why don't patients take their medicine? Reasons and solutions in psychiatry. *Advances in Psychiatric Treatment*, *13*, 336-346. https://doi.org/10.1192/apt.bp.106.003194

MOHNZ. (2021b). *Publicly funded hospital discharges – 1 July 2018 to 30 June 2019*. https://www.health.govt.nz/publication/publicly-funded-hospital-discharges-1-july-2018-30-june-2019

Moreno, J. M., Morales del Castillo, J. M., Porcel, C., & Herrera-Viedma, E. (2010). A quality evaluation methodology for health-related websites based on a 2-tuple fuzzy linguistic approach. *Soft Computing*, *14*(8), 887-897. https://doi.org/10.1007/s00500-009-0472-7

Mota, L., Ferreira, C. C. G., Costa Neto, H., Falbo, A. R., & Lorena, S. B. (2018). Is doctor-patient relationship influenced by health online information? *Revista da Associação Médica Brasileira*, *64*(8), 692-699. https://doi.org/https://doi.org/10.1590/1806-9282.64.08.692

Moynihan, R., Heath, I., & Henry, D. (2002). Selling sickness: the pharmaceutical industry and disease mongering. *British Medical Journal 324*(7342), 886-891. https://doi.org/doi: https://doi.org/10.1136/bmj.324.7342.886

Murakami, T. (2017). Absorption sites of orally administered drugs in the small intestine. *Expert Opinion on Drug Discovery*, *12*(12), 1219-1232. https://doi.org/https://doi.org/10.1080/17460441.2017.1378176

Mwita, S., Ngonela, G., & Katabalo, D. (2019). Disposal Practice of Unfit Medicines in Nongovernmental Hospitals and Private Medicine Outlets Located in Mwanza, Tanzania. *Journal of Environmental and Public Health*, *2019*, 7074959. https://doi.org/10.1155/2019/7074959

Narendran, R., & Narendranathan, M. (2013). Influence of pharmaceutical marketing on prescription practices of physicians. *Journal of the Indian Medical Association*, *111*(1), 47-50. https://pubmed.ncbi.nlm.nih.gov/24000508/

Nind, J., Smith, A., Devananda, M., & Auvray, B. (2021). A whole of population retrospective observational studyon the rates of polypharmacy in New Zealand 2014 to 2018Polypharmacy in New Zealand: What is the current status? *Health Science Reports*. https://doi.org/ DOI: 10.1002/hsr2.263

Okuboyejo, S. (2014). Non-adherence to medication in outpatient setting in Nigeria: the effect of employment status. *Global Journal of Health Science*, *6*(3), 37-44. https://doi.org/DOI:10.5539/gjhs.v6n3p37

Olaronke, I., Soriyan, A., Gambo, I., & Olaleke, J. (2013). Interoperability in Healthcare: Benefits, Challenges and Resolutions. *International Journal of Innovation and Applied Studies*, *3*, 2028-9324. http://www.issr-journals.org/ijias/

Paine, S., Thornley, C., Wilson, M., Dufour, M., Sexton, K., Miller, J., King, G., Bell, S., Bandaranayake, D., & Mackereth, G. (2014). An Outbreak of Multiple Serotypes of Salmonella in New Zealand Linked to Consumption of Contaminated Tahini Imported from Turkey. *Foodborne Pathogens and Disease*, *11*(11), 887-892. https://doi.org/10.1089/fpd.2014.1773

Panther, S. G., Knotts, A. M., Odom-Maryon, T., Daratha, K., Woo, T., & Klein, T. A. (2017). Off-label Prescribing Trends for ADHD Medications in Very YoungChildren. *The Journal of Pediatric Pharamacology and Therapeutics*. https://doi.org/https://doi.org/10.5863/1551-6776-22.6.423

Parker, R., & Pettijohn, C. (2005). Pharmaceutical drug marketing strategies and tactics: a comparative analysis of attitudes held by pharmaceutical representatives and physicians. *Health marketing quarterly*, *22*, 27-43.

Payne, R. A. (2016). The epidemiology of polypharmacy. *Clinical Medicine (London, England)*. https://doi.org/https://doi.org/10.7861/clinmedicine.16-5-465

Peake, B. M., Braund, R., Tong, A. Y. C., & Tremblay, L. A. (2016). Impact of pharmaceuticals on the environment. *The Life Cycle of Pharmaceuticals in the Environment*. https://doi.org/https://doi.org/https://doi.org/10.1016/B978-1-907568-25-1.00005-0

Pharmac. (2022b). *Prescriptions and units dispensed in financial year 2020/21* Pharmac. https://pharmac.govt.nz/news-and-resources/official-information-act/official-information-act-responses/prescriptions-and-units-dispensed-in-financial-year-202021/

Phillion, M. (2021). *Improving Medication Adherence Through Patient Centricity*. https://www.psqh.com/about/mission-statement/

Phuong, J. M., Penm, J., Chaar, B., Oldfield, L. D., & Moles, R. (2019). The impacts of medication shortages on patient outcomes: A scoping review. *PLOS ONE*, *14*(5), e0215837. https://doi.org/10.1371/journal.pone.0215837

Plafker, G. (1976). Tectonic aspects of the guatemala earthquake of 4 february 1976. *Science*, *193*(4259), 1201-1208. https://doi.org/10.1126/science.193.4259.1201

Pomare, E., & Ngata, P. (1992). Cultural Factors in Medicine Taking A Māori Perspective. https://pharmac.govt.nz/assets/cultural-factors-in-medicine-taking.pdf

Ponen, S., & Lambie, A. (2016, 3 August 2022). Health Navigator.

Ponen, S., & Lambie, A. (October, 2020). Medicines – expiry date. https://www.healthnavigator.org.nz/medicines/m/medicines-expiry-date/

Pouyan, N. (2016). MESOPOTAMIA, THE CRADLE OF CIVILIZATION AND MEDICINE. *World Journal of Pharmaceutical Research*, *5*, 192-225. https://doi.org/10.20959/wjpr20164-5895

Pringle, J., Hendry, C., & McLafferty, E. (2011). Phenomenological approaches: challenges and choices. *Nurse Res*, *18*(2), 7-18. https://doi.org/10.7748/nr2011.01.18.2.7.c8280

PSNZ. (2021). *Antimicrobial Stewardship*. https://www.psnz.org.nz/practicesupport/antimicrobial

Purdy, S. C. (2020). Communication research in the context of te whare tapa whā model of health. *International Journal of Speech-Language Pathology*, *22*(3), 281-289. https://doi.org/DOI: 10.1080/17549507.2020.1768288

Reid, K., Flowers, P., & Larkin, M. (2005). Exploring lived experience. *The psychologist*, *18*(20-23). https://psycnet.apa.org/record/2005-02203-005

Reuben, B. G. (2008). In C. G. Wermuth (Ed.), *The Practice of Medicinal Chemistry (Third Edition)* (pp. 894-921). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-374194-3.00045-7

Rheinberger, C. M., Herrera-Araujo, D., & Hammitt, J. K. (2016). The value of disease prevention vs treatment. *Journal of Health Economics*, *50*, 247-255. https://doi.org/https://doi.org/10.1016/j.jhealeco.2016.08.005

Rishoej, R. M., Almarsdóttir, A. B., Christesen, H. T., Hallas, J., & Kjeldsen, L. J. (2017). Medication errors in pediatric inpatients: a study based on a national mandatory reporting system. *Europen Journal of Paedeatrics*, *176*(12), 1697-1705. https://doi.org/10.1007/s00431-017-3023-8

Robertson, D. W., Bedell, R., Lavery, J. V., & Upshur, R. (2002). What kind of evidence do we need to justify humanitarian medical aid? *Lancet*, *360*(9329), 330-333. https://doi.org/10.1016/s0140-6736(02)09558-2

Roy, C. (2021). The pharmacist's role in climate change: A call to action. *Can Pharm J (Ott)*, *154*(2), 74-75. https://doi.org/10.1177/1715163521990408

Ryan, K., Bissell, P., & Morecroft, C. (2007). Narratives about illness and medication: a neglected theme/new methodology within pharmacy practice research. Part II: medication narratives in practice. https://doi.org/DOI 10.1007/s11096-006-9017-7

Sabatino, M. J., Kunkel, S. T., Ramkumar, D. B., Keeney, B. J., & Jevsevar, D. S. (2018). Excess Opioid Medication and Variation in Prescribing Patterns Following Common Orthopaedic Procedures. *J Bone Joint Surg Am*, *100*(3), 180-188. https://doi.org/10.2106/jbjs.17.00672

Safeer, R. S., & Keenan, J. (2005). Health literacy: the gap between physicians and patients. *American family physician*, *72*(3), 463-468. https://pubmed.ncbi.nlm.nih.gov/16100861/

Saleh, N. (2022). *The Risks of Using the Internet to Self-Diagnose*. https://www.verywellhealth.com/perils-of-using-the-internet-to-self-diagnose-4117449

Sarla, G. S. (2020). Efficacy and disposal of drugs after the expiry date. *The Egyptian Journal of Internal Medicine*. https://doi.org/https://doi.org/10.4103/ejim.ejim_110_19

Sayin, O., & Bozkurt, V. (2021). *Sociology of Coronovirus Conspiracies in Turkey: Who Believes and Why?* Istanbul University Press. https://doi.org/DOI:10.26650/B/SS49.2021.006.06

Schwartz, D. D., Axelrad, M. E., Schwartz, D. D., & Axelrad, M. E. (2015). Introduction: Definitions, Scope, and Impact of Nonadherence. *Healthcare Partnerships for Pediatric Adherence: Promoting Collaborative Management for Pediatric Chronic Illness Care*, 3-20.

Schwitzer, G., Mudur, G., Henry, D., Wilson, A., Goozner, M., & Simbra, M. (2005). What Are the Roles and Responsibilities of the Media in Disseminating Health.

Scott, M. (2021). 40 million of medicine a year wasted by donation rules. *Newsroom*. https://www.newsroom.co.nz/40-million-of-medicine-a-year-wasted-by-donation-rules#:~:text=An%20estimated%20%2440%20million%20of%20medicines%20are%20wasted,with%20no%20mechanisms%20to%20re-coup%20the%20money%20back.

Sen-Crowe, B., McKenney, M., & Elkbuli, A. (2021). Medication shortages during the COVID-19 pandemic: Saving more than COVID lives. *The American Journal of Emergency Medicine*, *45*, 557-559. https://doi.org/https://doi.org/10.1016/j.ajem.2020.07.044

Sharma, A. (2017). Role of Media in Health Communication. *Association for Progressive Communication*. https://www.apc.org/en/blog/role-media-health-communication

Sharma, A., Kumar, R., Aier, I., Semwal, R., Tyagi, P., & Varadwaj, P. (2019). Sense of Smell: Structural, Functional, Mechanistic Advancements and Challenges in Human Olfactory Research. *Current Neuropharmacology*, *17*(9), 891-911. https://doi.org/10.2174/1570159x17666181206095626

Sheth, A., Jaimini, U., Thirunarayan, K., & Banerjee, T. (2017). Augmented Personalized Health: How Smart Data with IoTs and AI is about to Change Healthcare. *International Forum on Research and Technologies for Society and Industry.*, *2017*. https://doi.org/DOI: 10.1109/RTSI.2017.8065963

Shinebourne, P. (2011). The Theoretical Underpinnings of Interpretative Phenomenological Analysis (IPA). *Existential Analysis: Journal of the Society for Existential Analysis*, *22*(1). https://psycnet.apa.org/record/2011-05339-003

Simoens, S. (2007). International comparison of generic medicine prices. *Current Medical Research and Opinion*, *23*(11), 2647-2654. https://pubmed.ncbi.nlm.nih.gov/17877848/

Singal, G. L., Nanda, A., & Kotwani, A. (2011). A comparative evaluation of price and quality of some branded versus branded-generic medicines of the same manufacturer in India. *Indian J Pharmacol*, *43*(2), 131-136. https://doi.org/10.4103/0253-7613.77344

Smith, J. A. (2010). Interpretative phenomenological analysis: A reply to Amedeo Giorgi. *Existential analysis*, *21*(2), 186-193.

Spencer, H. C., Campbell, C. C., Romero, A., Zeissig, O., Feldman, R. A., Boostrom, E. R., & Long, E. C. (1977). Disease-surveillance and decision-making after the 1976 Guatemala earthquake. *Lancet*, *2*(8030), 181-184. https://doi.org/10.1016/s0140-6736(77)90193-3

Sphere. (2021). https://spherestandards.org/about/

StatsNZ. (2020). *Ethnic group summaries reveal New Zealand's multicultural make-up*. Stats NZ.

Straka, R. J., Keohane, D. J., & Liu, L. Z. (2017). Potential clinical and economic impact of switching branded medications to generics. *American journal of therapeutics*, *24*(3), e278.

Strand, J. (1994). Strategies for improving patient compliance. *Physician Assist*, *18*(1), 48-50, 53.

Sundar, R. P., Becker, M. W., Bello, N. M., & Bix, L. (2012). Quantifying Age-Related Differences in Information Processing Behaviors When Viewing Prescription Drug Labels. *PLOS ONE*, *7*(6), e38819. https://doi.org/10.1371/journal.pone.0038819

Sung, C. L. (1999). Asian Patients' distrust of western medical care: one perspective. *Mt Sinai J Med*, *66*(4), 259-261.

Suzy.Kassem. (2011). *Rise Up and Salute the Sun: The Writings of Suzy Kassem*. https://books.google.co.nz/books/about/Rise_Up_and_Salute_the_Sun.html?id=aQO-bwAACAAJ&redir_esc=y

Tang, T. S., Solomon, L. J., Yeh, C. J., & Worden, J. K. (1999). The Role of Cultural Variables in Breast Self-Examination and Cervical Cancer Screening Behavior in Young Asian Women Living in the United States. *Journal of Behavioral Medicine*. https://link.springer.com/content/pdf/10.1023/a:1018653306776.pdf

Thomas, S. P. (2005). Through the lens of Merleau-Ponty: advancing the phenomenological approach to nursing research. *Nursing Philosophy: an international journal for nursing professionals*, *6*(1), 63-76. https://doi.org/10.1111/j.1466-769X.2004.00185.x

Tichy, E. M., Hoffman, J. M., Suda, K. J., Rim, M. H., Tadrous, M., Cuellar, S., Clark, J. S., Wiest, M. D., Matusiak, L. M., & Schumock, G. T. (2021). National trends in prescription drug expenditures and projections for 2021. *American journal of health-system pharmacy : AJHP : official journal of the American Society of Health-System Pharmacists*, *78*(14), 1294-1308. https://doi.org/10.1093/ajhp/zxab160

Toh, M. R., & Chew, L. (2016). Turning waste medicines to cost savings: A pilot study on the feasibility of medication recycling as a solution to drug wastage. *Sage Journals*, *31*. https://doi.org/doi.org/10.1177/02692163166397

Tomlin, A. M., Woods, D. J., Reid, J. J., & Tilyard, M. W. (2020). Trends in prescription medicine use by older people in New Zealand 2010– 2015: a national population-based study. *Vol 133 No 1513*. https://journal.nzma.org.nz/journal-articles/trends-in-prescription-medicine-use-by-older-people-in-new-zealand-2010-2015-a-national-population-based-study

Tseng, W.-S., & Streltzer, J. (2008). *Cultural Competence in Health Care*. https://doi.org/DOI: 10.1007/978-0-387-72171-2_1

Tsiros, M., & Heilman, C. M. (2005). The Effect of Expiration Dates and Perceived Risk on Purchasing Behavior in Grocery Store Perishable Categories. *Journal of Marketing*, *69*(2), 114-129. https://doi.org/10.1509/jmkg.69.2.114.60762

Turner, A. M., Osterhage, K. P., Taylor, J. O., Hartzler, A. L., & Demiris, G. (2018). A Closer Look at Health Information Seeking by Older Adults and Involved Family and Friends: Design Considerations for Health Information Technologies. *AMIA Annu Symp Proc*, *2018*, 1036-1045.

UN. (2022). *World Population Prospects 2022*. https://population.un.org/wpp/DataSources/

van der Geest, S., & Hardon, A. (2006). Social and cultural efficacies of medicines: Complications for antiretroviral therapy. *Journal of Ethnobiology and Ethnomedicine*, *2*(1), 48. https://doi.org/10.1186/1746-4269-2-48

van der Geest, S., Reynolds Whyte, S. R., & Hardon, A. (1996). The anthropology of pharmaceuticals: a biographical approach. *Annual Review of Anthropology*, *25*(1), 153-178. https://doi.org/https://doi.org/10.1146/annurev.anthro.25.1.153

Van der geest, S., Whyte, S., & Hardon, A. (2003). The Anthropology of Pharmaceuticals: A Biographical Approach. *Annual Review of Anthropology*, *25*, 153-178. https://doi.org/10.1146/annurev.anthro.25.1.153

Van der Walt, J. L. (2020). Interpretivism-constructivism as a research method in the humanities and social sciences-more to it than meets the eye. *International Journal of Philosophy and Theology*, *8*(1), 59-68. https://doi.org/DOI: 10.15640/ijpt.v8n1a5

Varghese, D., Ishida, C., & Koya., H. H. (2022). olypharmacy. *National Library of Medicine*. https://www.ncbi.nlm.nih.gov/books/NBK532953/

Vaughn, V. M., & Chopra, V. (2017). Revisiting the panculture. *BMJ Quality & Safety*, *26*(3), 236-239. https://doi.org/10.1136/bmjqs-2015-004821

Virdi, V. J. S., Gupta, M., & Gupta, R. (2021). Hurdles in Mandatory Generic Medicine Prescription. *Journal of Pharmacology and Pharmacotherapeutics*, *12*(3), 115-119. https://doi.org/10.4103/jpp.jpp_74_21

Vu, N. D. (2022). *Expiration Dates and Retessting of Pharmaceutical Ingredients* ARL Bio Pharma. https://www.arlok.com/news/Expiration-Dates-and-retesting

Vuckovic, N. (1999). Fast Relief: Buying Time with Medications. *Medical Anthropology Quarterly*, *13*(1), 51-68. https://doi.org/https://doi.org/10.1525/maq.1999.13.1.51

Wade, C. I., & Martinez, T. (2022). Young's Rule. In *StatPearls*. StatPearls Publishing. https://pubmed.ncbi.nlm.nih.gov/32119490/

Warnke, G. (2016). Hermeneutics. In *Oxford research encyclopedia of literature*.

Watanabe, J. H., McInnis, T., & Hirsch, J. D. (2018). Cost of Prescription Drug–Related Morbidity and Mortality. *Annals of Pharmacotherapy*, *52*(9), 829-837. https://doi.org/10.1177/1060028018765159

Webster, A., Douglas, C., & Lewis, G. (2009). Making Sense of Medicines: 'Lay Pharmacology' and Narratives of Safety and Efficacy. *Science as Culture*, *18*, 233-247. https://doi.org/10.1080/09505430902885631

Wessely, S., & Greenhalgh, T. (2004). 'Health for me': a sociocultural analysis of healthism in the middle classes. *Br Med Bull*, *69*, 197-213. https://doi.org/10.1093/bmb/ldh013

WHO. (2019). *Patient Safety*. https://www.who.int/news-room/fact-sheets/detail/patient-safety

Whyte, S. R., van der Geest, S., & Hardon, A. (2002). *Social Lives of Medicines*. Cambridge University Press. https://books.google.co.nz/books?id=hLQ79NmzeVsC

Wicke, P., & Bolognesi, M. M. (2020). Framing COVID-19: How we conceptualize and discuss the pandemic on Twitter. *PLOS ONE*, *15*(9), e0240010. https://doi.org/10.1371/journal.pone.0240010

Wieczorkiewicz, S. M., Kassamali, Z., & Danziger, L. H. (2013). Behind Closed Doors: Medication Storage and Disposal in the Home. *Annals of Pharmacotherapy*, *47*(4), 482-489. https://doi.org/10.1345/aph.1R706

Williams, S. J., & Calnan, M. (2013). *Modern medicine: lay perspectives and experiences*. Routledge.

Willner, S., Whittemore, R., & Keene, D. (2020). "Life or death": Experiences of insulin insecurity among adults with type 1 diabetes in the United States. *SSM - Population Health*, *11*, 100624. https://doi.org/https://doi.org/10.1016/j.ssmph.2020.100624

Wilson, I. B., Schoen, C., Neuman, P., Strollo, M. K., Rogers, W. H., Chang, H., & Safran, D. G. (2007). Physician-patient communication about prescription medication nonadherence: a 50-state study of America's seniors. *Journal of General Internal Medicine*, *22*(1), 6-12. https://doi.org/10.1007/s11606-006-0093-0

Wilson, N. L., Rickard, B. J., Saputo, R., & Ho, S.-T. (2017). Food waste: The role of date labels, package size, and product category. *SSRN Electronic Journal*, *55*, 35-44. https://doi.org/DOI:10.2139/ssrn.2700692

Wouters, O. J., & Kanavos, P. G. (2017). A comparison of generic drug prices in seven European countries: a methodological analysis. *BMC Health Services Research*, *17*(1), 242. https://doi.org/10.1186/s12913-017-2184-5

Wu, X.-y., She, D.-m., Wang, F., Guo, G., Li, R., Fang, P., Li, L., Zhou, Y., Zhang, K.-q., & Xue, Y. (2020). Clinical profiles, outcomes and risk factors among type 2 diabetic inpatients with diabetic ketoacidosis and hyperglycemic hyperosmolar state: a hospital-based analysis over a 6-year period. *BMC Endocrine Disorders*, *20*(1), 1-9. https://doi.org/DOI: 10.1186/s12902-020-00659-5

Yetisen, A. K., Martinez-Hurtado, J. L., Ünal, B., Khademhosseini, A., & Butt, H. (2018). Wearables in Medicine. *Advanced Materials*, *30*(33), 1706910. https://doi.org/https://doi.org/10.1002/adma.201706910

Yin, H. S., Parker, R. M., Sanders, L. M., Dreyer, B. P., Mendelsohn, A. L., Bailey, S., Patel, D. A., Jimenez, J. J., Kim, K. A., Jacobson, K., Hedlund, L., Smith, M. C., Maness Harris, L., McFadden, T., & Wolf, M. S. (2016). Liquid Medication Errors and Dosing Tools: A Randomized Controlled Experiment. *Pediatrics*, *138*(4). https://doi.org/10.1542/peds.2016-0357

Appendix A (Advert)

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

RESEARCH PARTICIPANTS NEEDED!

DO YOU OR SOMEONE YOU KNOW USE PRESCRIPTION MEDICATIONS?

HAVE YOU EVER WONDERED WHY EXPIRATION DATES ARE USED ON MEDICINES?

- Are you 18 years or over and reside in New Zealand?
- Do you use or have used prescription medications?
- Are you willing to share your understanding and experiences of medication expiry dates?

I am looking for participants for a research study on medications and expiration dates. The aim is to explore the way people interpret and understand expiration dates on medicines, specifically prescription medications and to investigate how reasons for adhering or ignoring affects medication usage and disposal. It is also to address and avoid current global medication wastage with redistributive policies.

Research will be conducted through an interview process where you will be invited to share your own experiences and understandings of prescription medications and the expiration dates.

Please email me for more information on participating in this study.

Email: **Susan.Frankland.1@uni.massey.ac.nz**

Appendix B (Research Questions)

School of Psychology
Massey University
Private Bag 102-904
North Shore
Auckland 0745
Tel +64 9 414 0800 ext 43116
Fax +64 9 441 8157

Medications: How do we understand expiration dates

My name is Sue Frankland and I am a Masters Psychology student at Massey University. I would like to welcome you and thank you for deciding to participate in this research study. This interview is for me, the researcher, to learn more about how you, the participant interpret and understand expiration dates of prescription medications, and what affect this has on your usage of these medicines. You may also learn more about opportunities for medicines to be redistributed to people in need, rather than disposing of medications which may still have potency. I will ask you a series of questions which you will be allowed to answer in your own words, at your own pace allowing me to understand your experiences with expiration dates from your perspective. This interview will take approximately one hour and can be terminated at any point, should you request it.

Questions:

1. Tell me a little about yourself (Age, Demographics)
2. Tell me for what reason you use/have used prescription medication?
3. When you receive medication do you check the expiry date?
4. If Yes/No – why?
5. What is your understanding of why expiration dates are used by Pharmaceutical companies?
5. Do you think it is okay to use medication after the expiry date?
6. What do you think would happen if medicine is used after the expiry date?
7. Would you use medication after the expiry date?

8. If Yes – What is the reason you would use expired medications?
9. Are there any particular medications you would not use after their expiry date?
10. If Yes – why these particular medications?
11. Do you think expired medications should be disposed of?
12. Please explain your answer
13. Have you heard of medication programs where unused medications can be distributed to people in need?
14. Do you support such an idea?
15. Do you think excess/expired medications should be redistributed?
16. Please explain your answer
17. Is there anything else you might like to add?

Appendix C (Research Information Sheet and Consent Form)

School of Psychology
Massey University
Private Bag 102-904
North Shore
Auckland 0745
Tel +64 9 414 0800 ext 43116
Fax +64 9 441 8157

RESEARCH INFORMATION SHEET

Medications: How do we understand expiration dates

Tēnā koutou,

You are being invited to take part in a research project, by Susan Frankland, from the School of Psychology at Massey University as part of a Master of Arts thesis. Before you decide to participate or not, it is important for you to understand why the research is being done and what participation will involve. Participation in this study is voluntary and we ask you to please take the time to read the following information carefully and discuss it with others if you wish. It is up to you to decide whether or not to take part. If you do, you will receive a copy of this research information sheet and will be asked to complete a consent form. You may withdraw from the study at any time without having to provide a reason and without affect. Please ask questions if there is anything you do not understand or would like more information on. Thank you for reading this information sheet.

Project Description and Invitation

The aim of this study is to explore the way people interpret and understand expiration dates on medicines, specifically prescription medications. I am interested in the diverse understandings of what medication expiry dates means to people and their reasons for adhering or ignoring these expiration dates. There is a global trend to the development of redistribution pharmacies where surplus medicines can be redistributed rather than disposed of unnecessarily. Understanding why people either adhere or ignore expiration dates will allow us to address ways to ensure adherence and completion of medications and avoid the current global medication wastage through redistributive policies.

Participant Identification and Recruitment

This research study will be advertised on a closed Facebook group page, and information flyers at general practitioner offices, with the permission of the practice manager. Anyone interested in participating in this study is invited to make contact with me through the details given below, to discuss involvement. If there is anyone else you would like to refer to this research, and who meets the inclusion criteria, my details below may be passed to them.

Inclusion criteria for the study include:

- Participants must be over the age of 18 years of age.
- Participants may be any gender or gender neutral; of any ethnicity or religious persuasion
- Participants must reside in Aotearoa New Zealand.
- Participants must have used or currently be using prescription medication

I am aiming to recruit between 18-20 participants in order to gather a broad range of perspectives and experience for the for study.

Risks and Benefits to Participants

Risks:

I do not anticipate that involvement in this study will cause risk or discomfort to participants. Interview questions will be through narrative and participants will be allowed to share their understandings in their own way, at a pace and comfortability decided by the participant. Any personal experiences will be of the participants choice with no pressure to divulge anything which they do not want to.

Benefits:

Participants may find it beneficial to share their understanding and experiences with prescription medications and pharmaceutical use of expiration dates and to learn about why these dates are used, the meaning behind them and how unused medications can and could be redistributed to those in need. This research may contribute to less medication wastage. There will be no monetary reward for participating in this research.

Study Procedures

If you decide to participate in this study, you will be invited to join a conversational interview, with me, the researcher, which should take around 1hour. During this interview, I will be asking questions about your understanding and experience with using prescription medicines and their expiry date. Interviews will either be face-face depending on Covid-19 restrictions, via video call or telephone. All audio from the interviews will be recorded. This recording, following your interview, will be transcribed by the researcher and a copy of this transcription will be emailed to you for your review, to ensure what has been transcribed is correct and that you are happy for it to be used in this research. You will be welcome to make any changes to your transcript at this point. The review will take approximately 1 hour and is optional.

Data Management

Throughout the research process your involvement in this study will be anonymous and further protected with the use of pseudonyms to identify participants. All data collected, will be stored on a password protected hard drive. Information, codes, recordings, transcripts and additional notes, will be kept confidential and only be accessed by myself and my supervisor, and used solely for the purposes of this project. Audio recordings of your interview will be deleted after they have been transcribed, and any information within your interview that may risk identifying you will be removed from your transcript and will not appear in the final publication. Any quotes used in the final publication will be attributed to a pseudonym to protect your privacy. You will be emailed a copy of your transcript unless you opt out of this, and the same will occur with the findings of the research following completion of the project.

Participant's Rights

Participants are under no obligation to participate in this study. If you decide to participate, you have the right to:

- You are under no obligation to accept this invitation. If you decide to participate, you have the right to:
    - Decline any particular question;
    - Withdraw from this study any time before you give final approval for the use of your interview transcript;
    - Ask any questions regarding the study, at any time during participation;

- Provide information with the understanding that your name will not be used unless permission is given to the researcher by yourself;
- Be given access to a summary of the project findings after it is concluded;
- Ask for the audio recorder to be switched off at any time during the interview

Thank you for taking the time to enquire about this project, and to read this information sheet. If you have any questions about the project, please do not hesitate to reach out to either myself, or my supervisor, Dr Kathryn McGuigan, at the details below.

Researcher: Sue Frankland
Email: Susan.Frankland.1@uni.massey.ac.nz

Supervisor: Dr Kathryn McGuigan
Email: K.Mcguigan@massey.ac.nz

Committee Approval Statement

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR21/95. If you have any concerns about the conduct of this research, please contact Dr Fiona Te Momo, Chair, Massey University Human Ethics Committee: Northern, telephone 09 414 0800 x 43347, email humanethicsnorth@massey.ac.nz.

School of Psychology

Massey University

Private Bag 102-904

North Shore

Auckland 0745

Tel +64 9 414 0800 ext 43116

Fax +64 9 441 8157

Medications: How do we understand expiration dates

PARTICIPANT CONSENT FORM

I have read, and I understand the Information Sheet attached as Appendix I. I have had the details of the study explained to me, any questions I had have been answered to my satisfaction, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to participate in this study and I understand participation is voluntary and that I may withdraw from the study up to up to giving final approval for the use of your interview transcript.

1. I agree/do not agree to the interview being sound recorded.
2. I wish/do not wish to have my recordings returned to me.
3. I agree to participate in this study under the conditions set out in the Information sheet.

Declaration by Participant:

I _____ [print full name]_____ hereby consent to take part in this study.

Signature: _____ Date: _____