1. Introduction

Very little research has been done to determine storage and disposal trends of medicine by the general public. There is a need to investigate this as the effects of improper storage and disposal methods can be detrimental – medicine that has expired or medicine that has been improperly stored may result in the medicine becoming toxic or ineffective due to the chemical alterations. Similarly, improper disposal of medicine result in damage to the environment.

This research study therefore aimed to investigate the storage and disposal of medicines by the public.

Within South Africa, public trends in storage and disposal of medicines are unclear. If it is commonplace for people in South Africa to improperly store and dispose of their medicinal products, these improper practices will need to be addressed. As custodian of medicine, no one is in a better position to educate the general public on proper storage and disposal of medicines than a pharmacist.

2. Background

Many consumers frequently change medicines, fail to read patient information leaflets, consume out-dated products, and are careless about the storage and disposal of their medicines. Studies1 have revealed that many people take
medicines prescribed by someone other than a health professional, and numerous people recommend their own prescribed medicines to family or friends. A growing concern is that many people ignore the use-by dates and keep their medicines in either the kitchen or bathroom where they could be affected by warm, steamy conditions. It is a common practice of the majority of the population to dispose of unwanted medicines in their household rubbish or through the sewage system.

Storage of medicine
Proper storage may be described as the safekeeping of medicines in an area that is suitable to maintain the stability of that medicine. Proper storage of medicine is a crucial aspect in the optimisation of safety and effectiveness of medication.

Most people are not aware of the instability of medicine-environmental factors such as heat, moisture, air and humidity are detrimental to medicine. These factors exist predominantly in the popular storage areas in the house, i.e. the bathroom and kitchen. The effect of the aforementioned factors leads to degradation of the drug by chemical alteration.

Drugs have specific storage conditions and adherence to these conditions impacts on the safety, life and efficacy of that drug. Literature provides specific conditions and guidelines for the suitable storage of drugs. Medicines must be kept in a secure area so that a child, teenager, pet or even a stranger does not have access to them therefore preventing accidental poisoning. Medicines must be kept separate from that of other family members, on different shelves or at least on a separate side of the shelf. This will make taking the wrong medication less likely. Medicines must be stored in the original dispensed packs and the assigned labels should not be removed from the medication. (This ensures that the correct medication in the correct dosage is consumed.) Storage advice on the label should be followed to ensure that healthcare products remain effective until their use-by-dates.

Heat and dampness can badly affect some healthcare products. These products should not be stored in the bathroom, near a sink, on window sills or in a car. Some products may need to be stored in the refrigerator. Lids on bottles must be kept tightly closed. A cap can not be child or waterproof if it is not fastened properly. If there is cotton in the bottle when first opened, it should be removed and thrown away. The cotton can absorb moisture and affect the medicine. Expired medication and discontinued medication should be kept in a separate and secure area for return to the pharmacy for disposal.

Disposal of medicine
Expired medicine presents a serious threat to public health or to the environment. Most expired medicine become less efficacious and a few may develop a different adverse effect profile. Similarly, improper disposal of medicine can also adversely affect health. Some of the health risks associated with improper disposal of medicine include:

- Contamination of drinking water (possibility of leachate entering an aquifer, surface water or drinking water system).
- Non-biodegradable antibiotics, antineoplastics and disinfectants may kill bacteria necessary for the treatment of sewage. Antineoplastics flushed into watercourses may damage aquatic life or contaminate drinking water.
- Burning pharmaceuticals at low temperatures or in open containers results in release of toxic pollutants into the air.
- Inefficient and insecure sorting and disposal may allow drugs beyond their expiry date to be diverted for resale to the general public.

Common routes of disposal of medicine by the public include the following:

- **Flush the medicines down the toilet.** Disposal via the toilet takes the drugs into the local sewage system. Water treatment plants are not fully designed to deal with medication disposal. The long term health risks posed by consumption of even minute amounts of the medicines in drinking water and exposure of aquatic life to such medicines are potentially fatal.
- **Pouring the medicines down the sink.** This is equivalent to flushing them down the toilet. The medicines shall end up in the same place. The consequences are much worse if the home uses a septic system. This can lead to the drug leaching out into the local water table and end up in a nearby lake or stream. This poses a danger of poisoning to children playing in the lake and pets and livestock drinking the water.
- **Throwing away medicines in the trash.** This is strongly discouraged since children or pets can find and be exposed to or even ingest the discarded medicines. This can lead to poisoning of children and animals, and even death, depending on the type and amount of medicine exposed to or ingested. It is recommended that local municipalities, local trash services employ secure household waste facilities where one can safely drop off medications for incineration.
- **Returning it to the pharmacy.** This is the most appropriate method to dispose of unused, unwanted and expired medications. It is recommended that pharmacies host a “clean out your medicine cabinet” drive that encourages the public to return old, expired or unused medications. Pharmacies generally use suitable waste containers to temporarily keep medicines. These are collected by specific waste collectors that dispose of pharmaceutical waste in a non-hazardous manner e.g. incineration.

Information on storage of medicine has been rated to be the least important part of a patient information leaflet by both pharmacists and the general public. This should actually be highlighted to the patient as this directly impacts on the safekeeping and efficacy of the chosen medication. Input from the pharmacist has been shown to influence the storage and disposal methods followed by patients and pharmacists should therefore take the time to discuss this with patients.
3. Methodology

3.1 Sample selection
A questionnaire was distributed amongst adults in five residential areas in the eThekwini area. The research sample comprised of 200 adults (40 adults per residential area) which were randomly selected.

3.2 Research questionnaire
The research questionnaire used in this study was based on previous related studies. A maximum of 20 questions were formulated ensuring that the questionnaire was short and did not abuse participants’ time. The questions were short and clear.

The questionnaires were divided into 3 sections:
• Demographics – general questions that determined age, race and gender of participants.
• Storage of medicines – questions that determined storage patterns
• Disposal of medicines – questions that determined disposal methods.

The questionnaire was a tick list, with instructions to the participant to answer the questions by ticking the most appropriate answer. The last question (asking participants to describe any harmful effects experienced from expired medication), was open-ended.

The questionnaire was tested using a small sample of test subjects, asking them to indicate if any question was not easily understandable and also to make suggestions on further options to the questions. The questionnaire was revised and adjusted accordingly.

3.3 Administration of Questionnaires
Randomly chosen participants were provided with information necessary for them to decide whether or not they wished to participate in the study. Once consent was given, the participant was instructed to answer the questions as truthfully as possible.

The questionnaire was not answered in the presence of the researcher to cancel out any intimidation or possible discomfort and to allow participants to answer as truthfully as possible.

3.4 Statistical Analysis
Two hundred questionnaires were distributed randomly.

The encoded answers were entered into Microsoft Excel spreadsheets. Those questions that were open-ended and those that had multiple responses were assigned to separate spreadsheets and each question with multiple responses was assigned a color. Data was analysed using Statistical Package for Social Sciences (SPSS).

4. Results
All the participants (100%) selected the correct definition of the term ‘storage’, indicating that it is the act of putting something in a particular place for safekeeping. 97.5% selected the correct definition for the term ‘disposal’ (the act of throwing something away or out). Most of the participants (69%) indicated that they purchase their medicine from the pharmacy. However, 31%, of the respondents admitted to buying medication from other places viz supermarkets, doctors and flea markets (Figure 1).

Over half of the participants (59.5%) responded that they were not told how to store their medications when purchased. Of the remaining 40.5% who were told how to store their medication, 84% of these were when they purchased medicine from a pharmacy. However, only 3.5% of the participants indicated that they based their storage area on the pharmacists’ advice.

90% of the participants stored all of their medication in one place, the most popular being in a locked cupboard (36.5%), followed by storage in the kitchen (24.5%), a bathroom cabinet (10.5%), the refrigerator (11.5%) or in a box (1%). The remaining 10% stored their medication in multiple places of storage (Figure 2).

The majority of respondents (48.5%) indicated that the area for storage of medicines was chosen based on the consideration that it had to be out of reach of children, while 35.5% of the participants chose a location for storage of medication based on convenience (Figure 3).

Most of the participants indicated that medicine was stored under correct storage conditions - 74.5% stored their medicine in an area that was cool and dry and that only adults within the
household had access to. This was further re-enforced by the finding that 69% of respondents indicated their medicinal storage area was locked at all times (Figures 4 and 5).

A relatively large percentage of the participants (32%) indicated that they remove medicines from the original containers, indicating a risk for premature degradation of medicine, and accidental poisoning.

75% of participants responded that they checked expiry date before purchasing their medication while 67% checked for expired medicines in their household prior to consumption. There were still many participants that never check for expiry dates of their medicine (25%). 14% of the participants indicated that there were expired medicines presently in their households.

Most participants disposed of medicine by throwing it away (62.5%), while a small percentage indicated that they flush expired medicine down the toilet (17%), pouring it down the sink (6.5%) and burying in the yard (2.0%). Only 2.5% indicated that they returned the medicines to the pharmacy for disposal (Figure 6).

Most individuals (91.5%) responded that they did not know of people or they themselves have not consumed expired medicines. However, since only 58% respondents indicated that they checked expiry date before consumption, it is difficult to assume that they have not consumed expired medicines. From the percentage of respondents that indicated that they know of someone or they themselves have consumed expired medicines (8.5%), the most common harmful effects reported were diarrhea, vomiting and nausea.

5. Discussion

Storage of medicine

Medicine should be used with caution; this includes the storage and disposal of these substances. It is therefore a concern that the general public, who are not always aware of optimum storage conditions for medication, are usually not informed of how to store medication and safely dispose of it. This study found that people are most often not informed of proper storage and disposal of medicine when purchasing medicine – this includes people buying medication from pharmacies. It is however heartening to know that, when people are informed of proper storage and disposal of medicine, this is done mostly by a pharmacist – a professional who is trained to advise patients on this.

When choosing where to store medication, most people base their choice on reasons of 1) safety and 2) convenience. It is however important to remember that, when living in a household where there are children, medication should be stored...
out of the reach of children, even if this might not be the most convenient location. This study found that most people are aware of these safety issues and store medication mostly in areas to which only adults have access.

While most people seem to store medicine under correct storage conditions, there still remain a small percentage of people who store medication in the bathroom or kitchen. Both of these locations are not ideal conditions for storage of medicine due to higher temperature and humidity levels. Medicine will degrade quicker than under normal storage conditions, hence the expiry date will not be an effective indicator to determine safety of these medicines anymore.

Disposal of medicine
Most people check for expiry dates on medication before taking it; there are however some people who admit to having taken expired medication in the past and having experienced adverse effects. Proper disposal of medication is very important as improper disposal methods can result in 1) harm to the environment or 2) be found in landfill sites and used. Other than what was found with storage of medicine, most people are not aware of, or do not practice proper disposal of expired/unused medicine. Most often medicine is thrown away as this probably seems the easiest way of disposing of medicine. People also tend to flush medicine down the toilet or pour it down the sink – all of which can result in harm to the environment.

Only a very small percentage of people return their expired / unused medication to the pharmacy for disposal. 2001

6. Conclusion
From the results, it is evident that people have some knowledge about storage of medicines, whilst inadequate or poor knowledge was displayed with regard to disposal of medicines. As a custodian of medicine, pharmacists should be more involved in informing people of proper ways to store and dispose of unwanted medication. Having awareness campaigns as well as collection points in the pharmacy where members of the public can return expired/unused medication, are some of the possible ways in which patients can be educated and assisted to properly dispose of medication.

References