Annex B

Water Research Commission project K5/2379:
Investigating the practice of open defecation post sanitation provision and the practice and implications of ingesting soil which may be contaminated

Review of literature and anecdotal accounts DRAFT

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September 2014

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1. INTRODUCTION

Ending open defecation has become a top priority on national and international agendas. On 28 May, 2014, the United Nations launched a new campaign to end the practice of open defecation worldwide and improve access to toilets and latrines for the 2.5 billion people living without basic sanitation (UN, 2014). The reason for this focus and urgency is that without toilets people defecate in the open and the faecal contamination of the environment that results is responsible for tragic and preventable death and disease. In fact, the urgency of this issue is so great that consideration has been made of making eradicating open defecation a separate UN development goal for the period 2015-2030 (Mollins, 2012). While the diarrhoeal diseases responsible for a high number of deaths among young children and vulnerable persons receive the most attention, open defecation is also a virtually sure route for the spread of helminthic infections which interfere with growth and cognitive development and impede educational and vocational aspirations. However, while the provision of toilets to all is an important strategy in the fight to eradicate open defecation, the assumption that open defecation ends where toilets begin is faulty. This flawed assumption can be found in many of the campaigns and reports produced by organisations promoting improved sanitation which often declare areas which have been provided with toilets as "open defecation free". As a result of this error, the data on open defecation is often skewed, presenting the picture that it has been eliminated while in reality it may well be continuing concurrent with the availability of basic sanitation. This means that sanitation interventions are not as effective as they may be considered to be, and this gap represents a serious health problem that is not being properly mapped or understood.

As a result of open defecation, not only harmful microbes but a vast number of helminth eggs are passed from infected individuals into the soil. Depending on the environmental conditions, these eggs may remain infective for a very long time. Consequently, where open defecation occurs or occurred in the past, the environment may remain contaminated for years after any visible evidence of a faecal deposit has vanished.

While helminthic infections often occur through accidental consumption of eggs from soil on dirty hands, a factor which makes the presence of this "egg bank" in the soil even more hazardous is the practice of intentionally eating soil -- called geophagia. Where the practices of open defecation and geophagia occur at the same household the risks of these combined behaviours as a route of transmission for helminthic and other infections may be particularly high. While the literature on the practice of geophagia is slim, what literature exists demonstrates that globally the practice is widespread; anecdotal accounts suggest that it is a very common practice in South Africa.

Because of the health implications of geophagia and open defecation in terms of helminthic infections and diarrhoeal diseases in particular, it is vital that health and hygiene interventions address these practices and provide clear information about disease transmission and the hygiene practices which can prevent it.

This review explores the literature relevant to the topics of open defecation, geophagia and soil- or faecally-transmitted diseases and interventions to address these, as well as anecdotal accounts of these topics from the areas targeted for this study (KwaZulu-Natal, Limpopo/Gauteng and Eastern Cape). A review of guidance on research methodology and health and hygiene materials will be added to this document at a later date.

2. OPEN DEFECATION

At the May 2014 launch of the United Nation's new campaign to end open defecation, UN Deputy Secretary-General Jan Eliasson powerfully made the case for addressing open defecation, saying:

> "I am moved by the fact that a child dies every two and a half minutes from diseases linked to open defecation. Those are silent deaths – not reported on in the media, not the subject of public debate. Let's not remain silent any longer."
>
> "If we could end open defecation in just 10 countries, we would see number of the people affected drop by 80%. If we end open defecation we would see direct reduction of 36% of deaths due to diarrhoea for children under 5, with the consequences of improved sanitation reaching even further." (UN, 2014)

Building on the commitment to sanitation made by UN member states at the meeting of the UN General Assembly in 2013, the UN's campaign aims to raise awareness of the reality of open defecation and end the practice by 2025.

> Sub-Saharan Africa is the only region in the world where open defecation is still increasing.
> - UN, 2014

The United Nations estimates that there are 2.5 billion people (about 35% of the world's population) who still do not use an improved sanitation facility and 1.1 billion (15% of the world's population) practising open defecation. In 2011, while almost two thirds (64%) of the global population had improved sanitation facilities, sub-Saharan Africa and Southern Asia still had low sanitation coverage. The UN reports that open defecation declined globally from 24% in 1990 to 15% in 2011. In Southern Asia, the proportion of the population using shared or unimproved facilities has declined to 18%, however 39% are still reported to practice open defecation – the highest of any region. In sub-Saharan Africa, 44% of the population is estimated as using either shared or unimproved facilities, with an estimated 26 % practicing open defecation. Sub-Saharan Africa is the only region in the world where open defecation is still increasing (ibid).

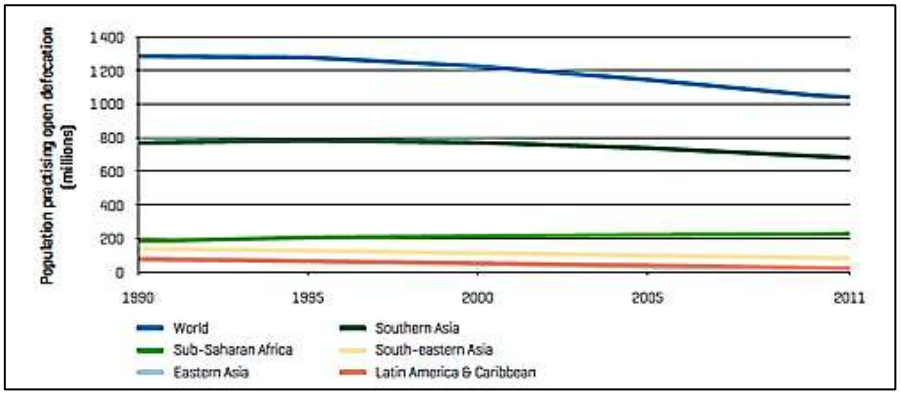

Figure 1 Open defecation trends in developing regions of the world, 1990 - 2011 (UN, 2014)

Because some figures for open defecation are linked to the provision of basic sanitation – where open defecation is where "people have no choice but to defecate outside, onto the ground and in full view of other people." (UN, 2014) it is unclear in many reports where numbers include those who elect to defecate in the open even when they have access to a toilet. While open defecation may be shrouded in silence in some communities because it is taboo, elective open defecation has often remained outside of the discourse of the international health and sanitation sector because it has been overlooked. The definition of open defecation used by the WHO and UNICEF is: "when human faeces is disposed of in fields, forests, bushes, open bodies of water, beaches or other open places or disposed of with solid waste" (WHO/UNICEF, 2013). By this definition open defecation is clearly not limited to those household which happen to have a basic sanitation facility, and yet in their data collection and analysis WHO/UNICEF open defecation is treated as the 'left-over" category. The data presented by WHO and UNICEF (2013) in the following figure, for example, is characteristic of many reports which shows open defecation as the percentage of the population that doesn't have improved, shared, or unimproved sanitation – representing a faulty assumption that where there is sanitation of any kind there is no open defecation and thereby underreporting the incidence of open defecation by failing to capture the overlap between open defecation and sanitation.

Figure 2 The "sanitation ladder" used by WHO/UNICEF (2013)

An awareness is lacking that after sanitation has been provided some individuals (though probably rarely entire households) might continue to

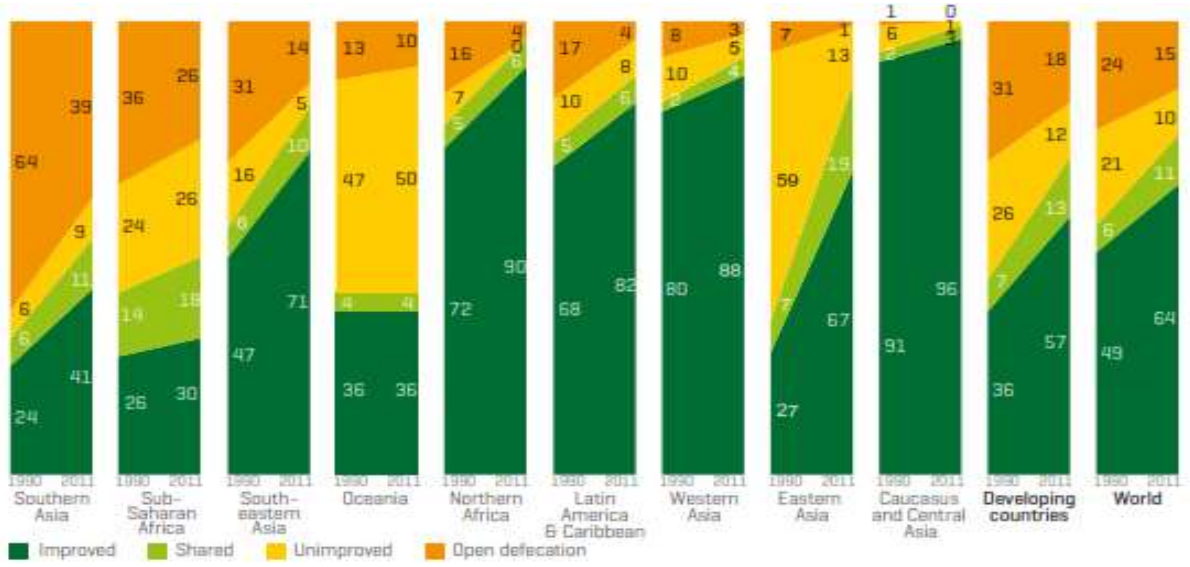

Figure 3 Sanitation coverage and open defecation, 1990-2011 (WHO and UNICEF, 2013)

elect to defecate in the open. The provision of toilets therefore does not neatly and automatically wipe out the ODF problem.

India has the largest number of people in the world - over 620 million - defecating in the open. With over 300,000 children under 5 dying each year due to diarrhoeal diseases, curbing open defecation is crucial (Prasad, 2014). India's new Prime Minister Narendra Modi has raised the ire of some during his election campaign for criticizing the prioritizing of building temples over building toilets, saying that despite his role as a religious leader he felt compelled to say "toilets first, temples later" (The Times of India, 2013). In his first Independence Day speech, he again made sanitation central: "Can we not create proper toilet facilities?" he said "I don't know whether people will appreciate my talking about dirt and toilets from the Red Fort but I come from a poor family. I have seen poverty and the attempt to give dignity to the poor starts from there." (Ghosh, 2014). Modi promised to build 5.3 million latrines by the end of his first 100 days in office -- one a second until August 31 2014 (Mehrotra, 2014). Modi's Swacch Bharat Mission, which he plans to launch on 2 October 2014 (the birthday of Mohandas Gandhi) aims to eliminate open defecation by constructing toilets in every household by 2019 (the 150th anniversary of Gandhi's birth) (Abbas, 2014). To this end, the Union Ministry for Drinking Water and Sanitation has initiated a project to build 20 million toilets by 2015. In addition, the Indian government has launched the 'Namami Gange' programme aimed at eliminating open defecation in the villages on the banks of the Ganges by 2022 by extending incentives to states to expand sewerage infrastructure to these communities (Mohan, 2014).

However, some doubt that the emphasis on building toilets will significantly impact open defecation.

In a Bloomberg article *India's toilet race failing as villages don't use them (2014)* Kartikay Mehrotra reports a recipient of one of the government's toilets stating that only dalits (the lowest Hindu caste) – or city dwellers with no other option -- should be exposed to excrement in a closed space. "Faeces don't belong under the same roof as where we eat and sleep," she said, indicating that the toilets provided to her village were not being used.

> "Not only you are not talking about open defecation, you are not even talking about how open defecation affects particularly women and girls. So every time they go out to defecate in the open – and by the way, open defecation is compromising euphemism as well, because frankly, we are talking about shitting in the open, this is what we are talking about. So, for women and girls to go out and defecate in the open, they face the risk of – each and every time – rape, sexual assault."
>
> Neo Ek Beng Mark, Deputy Permanent Representative of Singapore to the UN

The article quotes Yamini Aiyar, director of policy research group Accountability Initiative in New Delhi: "Targets for construction of toilets are somewhat irrelevant to resolving the sanitation problem," she explained: "Building toilets does not mean that people will use them and there seems to be a host of cultural, social and caste-based reasons for that. People need to be taught the value of sanitation."

Shannti Dinnoo, in an article on the subject for BBC (Dinnoo, 2014), comments that:

> "Apart from poverty and lack of lavatories, one of the reasons often cited to explain open defecation in India is the ingrained cultural norm making the practice socially accepted in some parts of the society."

She goes on to quote the head of UNICEF's WASH programme, Sue Coates:

> "Just building toilets is not going to solve the problem, because open defecation is a practice acquired from the time you learn how to walk. When you grow up in an environment where everyone does it, even if later in life you have access to proper sanitation, you will revert back to it."

A study published in 2014 measured the effect of India's Total Sanitation Campaign (TSC) on defecation behaviour, among other things, amongst roughly 3,000 households selected from villages in Madhya Pradesh (where funds had been offered for building toilets and education on the importance of ending open defecation). Over a 21 month period, there was a 19% increase of households opted to build a toilet and only 10% ended open defecation, with no improvement in child health measured in terms of multiple health outcomes (diarrhea, HCGI, helminth infections, anemia, growth (Patil et al, 2014). Among households with a toilet, approximately 40 % reported daily open defecation by men or women.

A Reuters article from 8 May 2014 shows that this awareness is beginning to change:

> Attempts to improve sanitation among the poorest have long focused on building latrines, but the United Nations says that money literally went down the toilet. Attitudes, not infrastructure, need to change, it said. "In all honesty the results have been abysmal," said Rolf Luyendijk, a statistician at the U.N.'s children's fund UNICEF.

"There are so many latrines that have been abandoned, or were not used, or got used as storage sheds. We may think it's a good idea but if people are not convinced that it's a good idea to use a latrine, they have an extra room." (Miles, 2014).

In the Democratic Republic of Congo, where 14% of the population is reported to be open defecators, the incidence of open defecation can be correlated to belief systems: 30% of households who are headed by an Animist practice open defecation, while 9% of those headed by a Jehovah's Witness do (Miles, 2014).

Galan et al (2013) in their study *Exploring changes in open defecation prevalence in sub-Saharan Africa based on national level indices* comment on the limitations of a strategy to reduce defecation that relies on sanitation delivery and discusses other approaches:

Breaking taboos:

"'Excreta', 'faeces', 'poo', I could even say 'shit' maybe, this is the root cause of so many diseases."

Bruce Gordon, acting coordinator for sanitation and health at the World Health Organization.

Ending OD is not just a matter of access to sanitation facilities: it also involves motivational drivers such as prestige, well-being, and situational goals. There is increasing value placed on motivating people to end OD, as evidenced by the United Nation's new Sanitation Drive 2015 advocacy campaign working to end OD—even if the resulting sanitation facility does not meet the standards of improved sanitation. Along these lines, new approaches are being implemented in an effort to reduce OD. The most promising approaches, referred to in this paper as total sanitation approaches, aim to empower communities as a whole to become 'OD free'. In contrast to past approaches that focused on individual households, total sanitation approaches target communities as a whole. Furthermore, total sanitation approaches promote use of local sanitation options that are based on affordability and available resources and reduce the role of hardware subsidies. This approach aims to raise awareness of the risks associated with OD and generates a collective sense of intolerance

towards OD. A number of questions remain regarding the effectiveness of this approach, especially in urban areas where communities may be less cohesive. There are also questions about the durability of the sanitation systems built as they are often inadequately constructed. Thus, many organizations are applying hybrid approaches that integrate more market-based methods that aim for both economic sustainability and the installation of better quality sanitation systems. Nevertheless, it has been suggested that total sanitation approaches can result in rapid, significant improvements, and holds promise for decreasing open defecation in sub-Saharan Africa.

In Pakistan Community-Led Total Sanitation has been supported by the national sanitation policy since 2006 (IRIN, no date). IRIN (no date) reports that the local NGO Rural Support Programmes Network (RSPN) has launched a campaign to raise awareness around the health risks associated with open defecation to effect behavioural change by using the approach of invoking a sense of shame, shock and disgust among local residents regarding their current toilet practices. Facilitated by social mobilisers from the community, community members are taken to the areas commonly used for defecation purposes in their village and then asked to calculate approximately how much human excrement they might produce on a daily basis. The residents were then asked for possible links with common diseases including diarrhoea, typhoid and malaria - and the resulting increased health costs. “We simply weren’t aware that these unhygienic practices led to diseases or that we could prevent them,” a 58-year-old resident was reported as saying.

Using another approach, in December 2014 Unicef India launched a digitally-led, interactive information campaign on open defecation called Take Poo to the Loo (#Poo2Loo/ www.Poo2Loo.com) with the aim of raising awareness among young people in order to mobilise a public movement with youth as advocates for ending open defecation (Sagar Media, 2013). The UN reports that making the practice unacceptable has worked in more than 80 countries. (Miles, 2014).

Literature investigating open defecation as a preference over using a toilet is scanty. The few reports that do explore this are not specific to the South African context and cultural factors which drive the practice do not always carry from one context to another. A review of a Community-Led Total Sanitation project in India found that in many communities in the Nanded area adults used their new toilets but children continued to be encouraged to defecate in the open (Gupta, 2012). A study on the defecation practices of young children in a Peruvian shanty town similarly found that defecation directly on the ground was common for children between the ages of one and three, as potty training was considered difficult and latrines were considered inappropriate for children under four (Yeagley, 1999). In campaigns conducted by the Water and Sanitation Program in Java to eliminate open defecation, it was found that proximity to a body of water significantly affected success because of the preference for defecating in a water body, and the "Open Defecation Free" status varied between 10-95% from one community to the next (Water and Sanitation Program, 2011).

Due to the lack of knowledge on the topic of the disposal of children's faeces, Gil et al (2004) conducted a systematic search of literature published between 1986 and 2002 to review the current state of knowledge of children's excretal practices. For the 33 studies conducted in 16 countries that were reviewed, defecation into the soil, either at the household level or in open fields or bushes, reached a prevalence rate of over 60% in children by 40 months of age. They also found that waste water from washing soiled diapers frequently contaminated the household soil. Risky behaviours

(open defecation, open stool disposal, stools not removed from soil or observed on the ground, child seen eating faeces) were associated with a significantly increased risk for diarrhoeal diseases.

Observations made by Partners in Development during field work suggest that in KwaZulu-Natal it is common practice for young children to be allowed, and perhaps encouraged, to defecate outside rather than using the toilet. In interviews conducted by PID for WRC project 2198 in May 2013 with 20 school children, 38% of respondents indicating there were young children at home reported that they regularly defecate outside. At Bathokuhle, a preschool in the Slangspruit community of Pietermartizburg, Partners in Development workers noted multiple deposits of faeces around the play area, indicating that open defecation was common practice. When preschool staff were asked about this, they said that they didn't know how to prevent children from defecating in the open, implying that this was their usual behaviour at home which they brought to school. However, a staff person was observed pulling down a young child's pants and directing her to the play area to relieve herself, demonstrating that some staff actively encourage, and perhaps even insist on, the practice themselves. In a survey of three communities in KwaZulu-Natal it was found that open defecation was still practiced by a significant number of children, and occasionally adults, in communities provided with indoor low flush latrines (Still & Louton, 2012). Reports of open defecation ranged from 26% to 35% of households interviewed across 3 communities; this figure can be expected to be lower than the actual incidence as the respondents may not have represented the behaviour of all members of the households and due to social disapproval may have underreported. Disposal of grey water, which may include faeces in water used for washing nappies or bottoms, into the household environment ranged between 55% and 88% across the 3 communities.

	Open defecation			Greywater disposal outside	
France	30%	(3/10)		55%	(12/21)
KwaNzimakwe	35%	(8/23)		88%	(22/25)
Ifafa Grebe	26%	(6/23)		81%	(18/21)
Average	30%	(17/56)		78%	(52/67)

Free ranging of pigs has been noted in some of these communities as well; the possibility of open defecation spreading infections by *Taenia solium*, which is responsible for cerebral cysticercosis, is a serious concern.

Anecdotal accountsThe following information was gathered from informal interviews and discussions conducted during September 2014.

2.1.1 KwaZulu-Natal

Informants reported that open defecation was common among young children, with a child as old as 8 reported to defecate outside regularly. The following reasons were given for children and adults defecating outside:

Reasons given for open defecation	
Children	Adults
Toilet seat too high Infant (left without nappy) Toilet seat too large (risk of falling in) Toilet structure, pedestal or pit unstable Afraid to go out to the toilet at night	Pits full No toilet Toilet structure, pedestal or pit unstable Unsafe to go out to toilet at night

In some cases children were given a bucket to defecate in; the contents were then emptied either into the bushes or into the toilet. In most cases, however, children were reported to defecate on the ground. Children were reported to defecate in the area where they play outside (where chickens may also be ranging) in the bushes or behind the toilet. One respondent indicated that children are discouraged from defecating in the pathway leading to the house, while another indicated that young children defecate in the area where people walk. In some cases adults then removed the faeces with a spade to the toilet or covered it with soil. In other cases faeces were left exposed; dogs and chickens were reported eating faeces in some cases. It was noted that at crèches some children may be too young to ask for assistance to go to the toilet and so simply defecate wherever they are.

One respondent reported that when her nephew defecates an adult holds his bottom under the tap to wash it and then dries it with a towel (no soap is used). There is no drain under the tap and so water containing faeces spreads out over the ground. The respondent indicated that this is not a problem as the sun dries up the water eventually. She indicated that the mother of the child is concerned that he could eat his own faeces or faeces from the chickens ranging in the same area. A few respondents indicated a concern that flies could carry pathogens from the exposed faeces to food in the house and that this could be a risk for worm infections.

One respondent indicated that it is understandable for adults to defecate near the house at night instead of walking through the darkness to the toilet.

Disposal or washing of nappies

All respondents reported the use of disposable rather than washable nappies. Disposable nappies were reported by one respondent to be thrown into an old toilet pit which has broken down; dogs however are able to access the rubbish here. Another respondent reported throwing nappies into the toilet pit. In communities with no municipal rubbish collection open disposal is common.

Figure 4 A dry streambed where disposable nappies and other rubbish are discarded in a peri-urban community which is not provided with rubbish collection by the city

2.1.2 Eastern Cape

Respondents had either pit or flush toilets, with those with pit toilets reporting that they did not like them. Their concerns around the pit toilets were the presence of germs, having to see faeces through the pedestal, and the fear of both adults and children that children could fall into the hole. Respondents indicated that anyone who was fearful of their toilet would elect to defecate outside and that when young children don't have someone to help them use the toilet they will defecate outside. Respondents believed that in the days before toilets people used to defecate in the bushes, fields or behind big rocks near the river. Their elders indicated that open defecation is acceptable, especially for young children. Morning or midnight were preferred times to defecate in the open -- when you cannot be seen. While most reported children under the age of 6 defecating outside, one 20 year old respondent indicated that she does as it feels safer and she feels more relaxed. Typically open defecation is done behind the toilet. Faeces is sometimes eaten by dogs. Respondents had mixed responses as to whether there were health issues related to open defecation. One reported that people defecated where vegetables were grown and they did not feel there were health risks associated with eating the vegetables.

Respondents indicated that disposable nappies are used in their families. These are disposed of either by throwing them into the pit latrine or by putting them into rubbish bags which are collected.

Generally respondents don't like to poo outside but feel it is better than using the toilet if they are scared of it. Respondents generally feel it is not healthy but there is no other option in some cases.

3. PATHOGENS IN FAECES

The general microbial population present in faeces which can cause infection consists of bacteria, viruses, protozoa and helminths (intestinal worms). The type and number of organisms in sludge will vary from one community to the next depending on the infections found in individuals in that community. Approximately two billion people are infected with soil-transmitted helminths worldwide (WHO, 2012). Some organisms, such as viruses, can be shed in large quantities even by carriers who are healthy.

In the South African context, where rates of infection with HIV and TB are high, the consequences of diarrhoeal diseases or loss of nutrients to parasites can be dire.

Data on parasitic infections in South Afria are scarce, however in a study analysing 5 733 stool samples from 32 public hospital laboratories across KwaZulu-Natal, evidence of helminth infections were found in 21.7% of samples and protozoan infections in 6% of the samples (Kwitshana, Tsoka and Mabaso, 2008). *Ascaris lumbricoides* (10.7%) and *Trichuris trichiura* (6.7%) were found to be the most prevalent helminths, and *Entamoeba coli* (2.8%) the most prevalent protozoan, with infections of these parasites documented in all health regions of the province.

Mortalities resulting from parasites are difficult to quantify as infections and symptoms may not be detected or diagnosed. Estimates of deaths caused by soil-transmitted helminths (primarily *A. lumbricoides*, *T. trichiura* and hookworm species) globally range from 12 000 to as high as 135 000 per year. (Bethony et al, 2006). While helminthic infections can be asymptomatic, they represent an important cause of nutritional deficiencies as well as impaired physical and cognitive development among children (WHO, 2005). Among the resulting impacts of this are a 23% drop in school attendance and 40% lower future earnings as adults for children with helminthic infections (CWW, 2011).

In South Africa, diarrhoeal diseases are the 8th largest cause of death nationally (Lewin, 2007), accounting for 3% of total deaths, and the third largest cause of death among children under 5, responsible for 11% of deaths in this age group. Table 3.1 shows the mortality rate among South African children under 5 compared with neighbouring countries and with countries with relatively low rates.

Table 1 Comparison of mortality rate for children in (per 1000 live births) for 2008 (UNICEF/WHO, 2009)

Countries with relatively low rates		South Africa and neighbouring countries	
Sweden	3	Botswana	31
Japan	4	Namibia	42
Germany	4	Zimbabwe	57
Cuba	6	South Africa	67
United States	8	Mozambique	130

3.1 Pathogens causing diarrhoeal diseases

Diarrhoea, which can be life threatening for vulnerable populations, is a common manifestation of infections caused by bacteria, viruses and protozoa (UNICEF/WHO, 2009). Acute watery diarrhoea, which can be caused by *V. cholerae*, pathogenic strains of *E. coli* or viruses such as the human rotavirus, can cause significant fluid loss resulting in rapid dehydration lasting for several hours or days. Bloody diarrhoea, or dysentery, is most often caused by *Shigella* spp. and can cause intestinal damage, resulting in nutrient loss and blood in the stools (UNICEF/WHO, 2009). Persistent diarrhoea, which continues for more than two weeks, can be a risk for children who are malnourished or have other illnesses, such as AIDS (UNICEF/WHO, 2009).

Persistent diarrhoea is associated with an 11-fold increase in mortality for children with HIV compared to uninfected children. (Tindyebwa, et al., 2004 in UNICEF/WHO, 2009). Checkley et al (2008) found that a higher cumulative burden of diarrhoea increased the risk of stunting for 24-month-old children. It is also the third greatest contributor to the burden of disease, constituting 8.8% of all disability-adjusted life years (DALYs) in this age group (Lewin, 2007). The estimated incidence of diarrhoeal disease in under-5s in 2004 – derived from cases presenting to primary health facilities, and therefore likely to be an underestimate of true incidence -- was 129/1 000, (Lewin, 2007) nationally. This varied widely between provinces, from 8/1000 in Gauteng to 244/1 000 in KwaZulu-Natal. In a study conducted by the eThekwini Metro Municipality (Buckley et al, 2008) the incidence of diarrhoea was found to be 3.3 per 1 000 person days. A study in Port Elizabeth found incidents of diarrhoea to be greater among children under the age of 6 who shared a toilet with more than five other households and transmission of diarrhoeal diseases at childcare facilities has been found to be significant (Lewin, 2007). Esrey et al (1991) have suggested that good hygiene may result in a 33% reduction in diarrhoeal mortality.

Bacteria responsible for diarrhoea

Shigella spp causes over two million infections and about 60 000 deaths every year, mainly in developing countries (WHO, 2011**)**. It has a very low infective dose of about 10-100 organisms (WHO, 2011**)**. *Campylobacter jejuni* is known to cause gastroenteritis worldwide. It has a very low infective dose as compared to other bacterial pathogens and is common in the environment (WHO, 2011*).* Brown (1997) reports that illness due to *salmonella spp* in healthy adults has been documented after consumption of less than 100 organisms per 100g; higher numbers perhaps shorten the incubation period.

E coli is indigenous to the intestines of humans and animals, where it generally causes no harm. In other parts of the body, however, it may cause urinary tract infections, bacteraemia, meningitis and even death (WHO, 2011). Pathogenic strains of *Escherichia coli* have been implicated in large disease outbreaks recently in Europe which have typically been related to contamination from faecal matter. Humans are the major reservoir of enteropathogenic *E. coli* strains which have been divided on the basis of their different virulence factors. These include enterotoxigenic *E. coli* (ETEC), enteropathogenic *E. coli* (EPEC), enteroinvasive *E. coli* (EIEC), enteroaggregative *E. coli* (EAEC), diffusely adherent *E. coli* (DAEC) and enterohaemorrhagic *E. coli* (EHEC) (serotypes: *E. coli* O157:H7 and *E. coli* O111) which have a high rate of mortality (ibid). While infections by these strains of bacteria are not as common as infections caused by *Campylobacter,* the infective dose can be less

than 100 organisms (ibid). Individuals can be carriers of strains of *E coli* and exhibit no symptoms (Knight, pers. comm., 26 Nov 2012).

EPEC has been frequently associated with severe, chronic, non-bloody diarrhoea, vomiting and fever in infants. Infants infected with this strain suffer from malnutrition, weight loss and growth retardation (WHO, 2011). EIEC is a pathogen commonly associated with infections such as watery and occasionally bloody diarrhoea. These strains have a similar pathogenic colon cell invasion mechanism to that of *Shigella* (WHO, 2011).

Viruses responsible for diarrhoea

Viruses are very small and have a low infective dose (Epstein, 1998; WHO, 2011). The major viruses infecting humans are identified as rotaviruses, enteroviruses and noroviruses (WHO, 2011). Rotaviruses and enteroviruses cause the highest burden of disease. Rotavirus is the leading cause of acute diarrhoea, and is responsible for about 40 per cent of all hospital admissions due to diarrhoea among children under five worldwide (UNICEF/WHO, 2009). In children, rotaviruses causing gastrointestinal infection can lead to hospitalization or, in severe cases, death (WHO, 2011).

3.2 Hepatitis A

Hepatitis A is virus which, while not responsible for diarrhoeal disease, is a concern with regard for open defecation and geophagia as the main route of infection by hepatitis A is faecal-oral transmission. Infection by hepatitis A in childhood is usually asymptomatic while disease in adults is more severe (NICD, 2007). Hepatitis A may cause liver disease and may manifest with symptoms such as tiredness, nausea, abdominal pain, jaundice, diarrhoea or loss of appetite (CPWR, 2012). Infections are frequently subclinical, however, and do not manifest overt symptoms. Because of this, analysis of the presence of antibodies in the blood is required for diagnosis (Brown, 1997). Hepatitis A is resilient in the environment and can persist for long periods even under adverse conditions (NICD, 2007).

The risk of infection by hepatitis A is linked largely to how prevalent it is in the community. In South Africa, Hepatitis A is endemic, however the true burden of disease is unknown as most infections are asymptomatic and illness is underreported (NICD, 2012). A 1994 South African study found over 90% of black adults, but only 40-60% of white adults, positive for hepatitis A virus-specific IgG (NICD, 2012). A survey conducted in 1998/9 found 80% of children from lower socio-economic communities, and 24% of children in higher socio-economic groups, to be seropositive by 11-13 years of age (NICD, 2007).

3.3 Helminths

3.3.1 Prevalence

Ascaris lumbricoides, Trichuris trichiura and hookworm, known as soil-transmitted helminths (STHs), are responsible for a major burden of disease around the world are of particular concern in warm climates with adequate moisture. Sub-Saharan Africa is the area of the world most affected by soil transmitted helminths (GAHI, 2013). While estimates of numbers of helminthic infections in South Africa are not available, studies indicate that the estimated 57% of South Africans who live in

poverty carry the highest burden of both HIV and helminthic infections (Mkhize-Kwitshana et al, 2011).

In South Africa, the highest prevalence of soil transmitted helminths is in the KwaZulu-Natal coastal area (Appleton et al, 2009), with temperature and moisture (altitude and latitude) affecting prevalence across the province. In a study of school children conducted in KwaZulu-Natal (Appleton and Gouws, 1996), the prevalence of *T. trichiura* and *A. lumbricoides* increased with decreasing altitude: at approximately 1700 metres above sea level less than 20% of subjects were infected while over 80% of participants were infected at the coast. Prevalences were highest between 1000 and 2000m, with lower temperatures probably being a limiting factor for *T. trichiura* at higher altitudes and rainfall a limiting factor for *A. lumbricoides* at lower altitudes. In a study conducted in Qwa-Qwa, a mountainous area (1500 to 3000 m above sea level) neighbouring Kwa-Zulu Natal, Mosala et al (2001) recorded *A. lumbricoides* infection levels ranging seasonally from 3.8% in summer to 2.1% in winter, and for *T. trichiura* from *0.8%* in summer to 0.2% in winter. *T. trichiura* was not found above 2000m. Appleton, Maurihungirire and Gouws (1999) found that the prevalence of *N. americanus* decreased from north to south. This was true to a lesser degree for *Strongyloides stercoralis*. Hookworm and *S. stercoralis* infections appeared to stop at 31^{o}S.

Other studies investigating the burden of disease among children in KwaZulu-Natal confirm *A. lumbricoides* and *T. trichiura* as the most prevalent helminths in the province, although far higher infection rates are documented. This may be attributed to the fact that school children are at greatest risk for parasitic infection (Appleton and Gouws, 1996). In a study investigating the prevalence of helminthic infections among school children along a 1000km long transect through the coastal plain of KwaZulu-Natal. Appleton, Maurihungirire and Gouws (1999) found mean infection as high as 69% for *A. lumbricoides* and 89.5% for *T. trichiura.* Infection among children in a Durban slum was found to be 89.2% for *A. lumbricoides* and 71.6% for *T. trichiura* (Appleton et al 2008). In interviews with 22 school conducted by PID in rural KwaZulu-Natal in May 2012, 55% respondents reported having actually witnessed worms exiting a person's body, highlighting the prevalence of infection in these communities (unpublished data).

In studies conducted in the informal settlement of Kayalitsha in the Western Cape, helminthic infection rates at 12 schools were found to be over 90%; 70% of adults in the community could recall having been infected with helminths (Mkhize-Kwitshana, 2012).

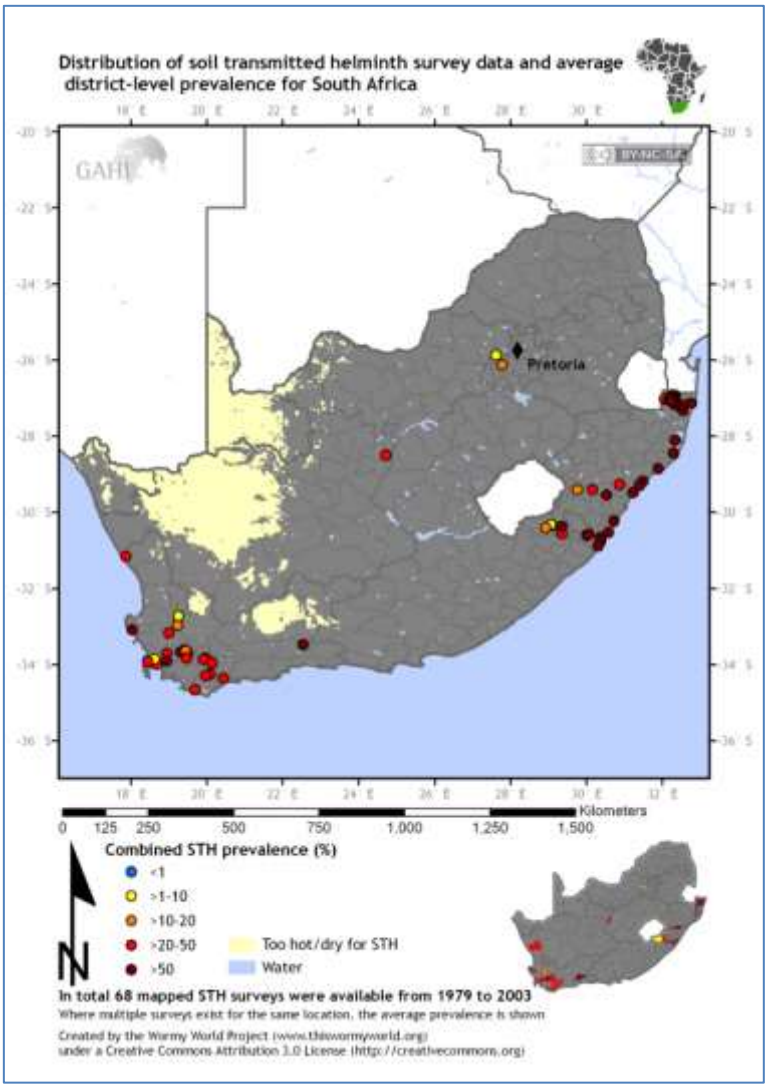

Figure 5 Mapping of 68 surveys of STHs in South Africa

A higher burden of disease resulting from Taenia solium (tapeworm) has been documented in the Eastern Cape (former Transkei) in South Africa for decades, with a 1965 study suggesting that cerebral cysticercosis (caused by T. solium cysts in the brain) was twice as high among people in that area than among other groups or regions in the country (Mafojane et al, 2003). Mafojane et al (2003) reports that a study in 1984 found 51% of the patients with cerebral cystercercosis at Groote Schuur hospital to be children, 43% of whom had epilepsy, 34% raised intracranial pressure, 13% meningo-encephalitis, 10% hydrocephalus; two of the children in the study died of complications caused by neurocysticercosis (ibid). An analysis conducted in 2004 found the burden of disease for the Eastern Cape Province alone to be between USD 18-34 million per annum, with epilepsy (34 662 cases) accounting for the largest overall impact (Carabin et al, 2006). As the disease is, in theory, easy to control, the International Task Force has declared T. solium eradicable (Carabin et al, 2006).

The free ranging of pigs, poor sanitation and lack of knowledge among the public about modes of transmission combine to make disease reduction a challenge, however.

Fincham and Dhansay, in a policy brief for the SA Medical Research Council in 2006 present the following facts regarding helminthic infections among children in South Africa:

- Disadvantaged children carry the greatest load
- For more than fifty years intestinal and biliary duct obstructions caused by A. lumbricoides have been a frequent cause of acute abdominal emergencies in children admitted to hospitals in Cape Town and Durban. Surgery is sometimes necessary. Obstructions also occur in adults, although less frequently.
- In 2005, tests detected the presence of tapeworm cysts in 10% of 400 volunteers from the Oliver Tambo and Alfred Nzo districts in the Eastern Cape. The cysts are often in the brain and are a major cause of epilepsy and other serious complications. The problem is not restricted to the Eastern Cape.
- More than 90% of the children attending 12 primary schools serving two large informal settlements in Cape Town were found to be infected with worms in 1999.
- A study of worm infection in children aged 2–10 years living in ten areas described as 'slums' in Durban was completed in 2001. The prevalence of A. lumbricoides and T. trichiura was 89.2% and 71.6% respectively, indicating that most of the children were infected with both worms.
- In Limpopo in 2005, 80% of school children in a study had bilharzia. Girls (71%) and boys (63%) were often infected with both the urinary and intestinal forms of the disease. Many complications can occur, including liver and/or kidney failure. Also, people who are infected with bilharzia have an increased risk of becoming infected with HIV. This is due to the sharp and irritant worm eggs which, when passed through the urogenital tract, cause lesions that bleed and are inflamed – in areas of the body that come into contact with possibly infected semen and vaginal fluids. Bilharzia and HIV/AIDS are co-endemic in parts of five provinces: Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga and North West.
- In the Free State, results reported in 2003 showed that pinworm, a cause of peri-anal irritation, sleep disturbance and stress for the whole family, can be present in up to 45% of children.
- Vaccination against several diseases (cholera, tuberculosis, tetanus and probably others) is known to be more effective in children who are not infected with worms. When most children in an area are infected with worms, prevention of major epidemic diseases by means of immunisation will therefore be less effective, and overall health costs will increase.
- Worm-related anaemia can be a serious impediment to health, especially in younger children.

3.3.2 Epidemiology

The table below indicates some of the common helminths, associated syptoms and the incidence of infection in KwaZulu-Natal documented by Kitshwana et al (2008).

Table 2 Helminths which pose a risk to health (Sources: Friis, 2001, Brown, 1997, CPWR, 2012, Singh et al., 2011; WHO, 2011)

HELMINTHS (Parasitic intestinal worms)		
Organism	**Disease and typical symptoms**	**Infection rate in KZN documented by Kitshwana et al, 2008 (%)**
Ascaris lumbricoides	Ascariasis, Often none; coughing or difficulty breathing, intestinal pain, constipation.	10.69
Trichuris trichura (whipworm)	digestive disturbances	6.7
Hookworm species (incl Necator americanus)	Often asymptomatic; gastrointestinal symptoms, blood loss leading to anaemia.	1.8
Strongyloides stercoralis	Anaemia, rashes, gastrointestinal symptoms	0.26
Enterobius vermicularis	Anal itching	0.03
Fasciola hepatica (liver fluke)	Fever, malaise, enlarged liver, abdominal pain	
Schistosoma haematobium	schistosomiasis	0.2
*Taenia spp (*incl *Taenia solium, Taenia saginata)*	Nervousness, insomnia and anorexia, epilepsy, cysticercosis	0.78
Schistosoma mansori	Nervousness, insomnia and anorexia	1.03
Hymenolepis nana	Usually asymptomatic	0.21
Dipylidium caninum	Loss of appetite; indigestion	
Ancylostoma duodenale (hookworm)	Anaemia	

Ascaris lumbricoides is the largest roundworm parasitizing the human intestine, infecting an estimated 807-1,221 million people worldwide (CDC, 2012). Ascariasis is prevalent in the Durban area among poorer communities (Buckley et al, 2008b). Most infections occur in people 10 years old or younger (Mayo Clinic, 2012). Adams et al (2006) propose that infected adults may typically be in a state of immunological holoendemic equilibrium which reduces infection.

Microscopic *A. lumbricoides* eggs are passed in the faeces of infected persons. Fertilized eggs must spend at least 18 days while they embryonate before they become infective (Mayo Clinic, 2012). The ideal conditions for this are moist, warm soil that is shaded; if these conditions are not met the embryo may take several weeks to become infective (CDC, 2012). Once infective, eggs may remain viable for up to 15 years (Buckley et al, 2008b).

Infection occurs when infective eggs enter the mouth through contaminated hands or food and are swallowed. This mode of transmission was discovered by Davaine, a French scientist who in 1862 infected himself with the eggs of *A. lumbricoides* and observed eggs subsequently in his faeces (Cox, 2002). The eggs hatch in the small intestine of the host and the larvae penetrate the intestinal wall and travel to the lungs via the bloodstream or lymphatic system, where they mature for 6-14 days in the lungs (CDC, 2012, Mayo Clinic, 2012). After this they break into the airway, travel up the throat, and are then coughed up and swallowed (Mayo Clinic, 2012). The migration of larval stages of *A.*

lumbricoides was discovered by Koino, a Japanese pediatrician, in 1922 when he infected himself and subsequently found large numbers of larvae in his sputum (Cox, 2002). Once the larvae have returned to the intestines, they mature into adult worms. The period from ingestion of infected eggs to production of eggs by a mature female takes 2-3 months (CDC, 2012). Females can grow to be over 40cm while males tend to be smaller (Mayo Clinic, 2012). Females can produce 200,000 eggs per day which are passed in the stools. The lifespan of *A. lumbricoides* is 1-2 years; they remain in the intestine until they die (CDC, 2012).

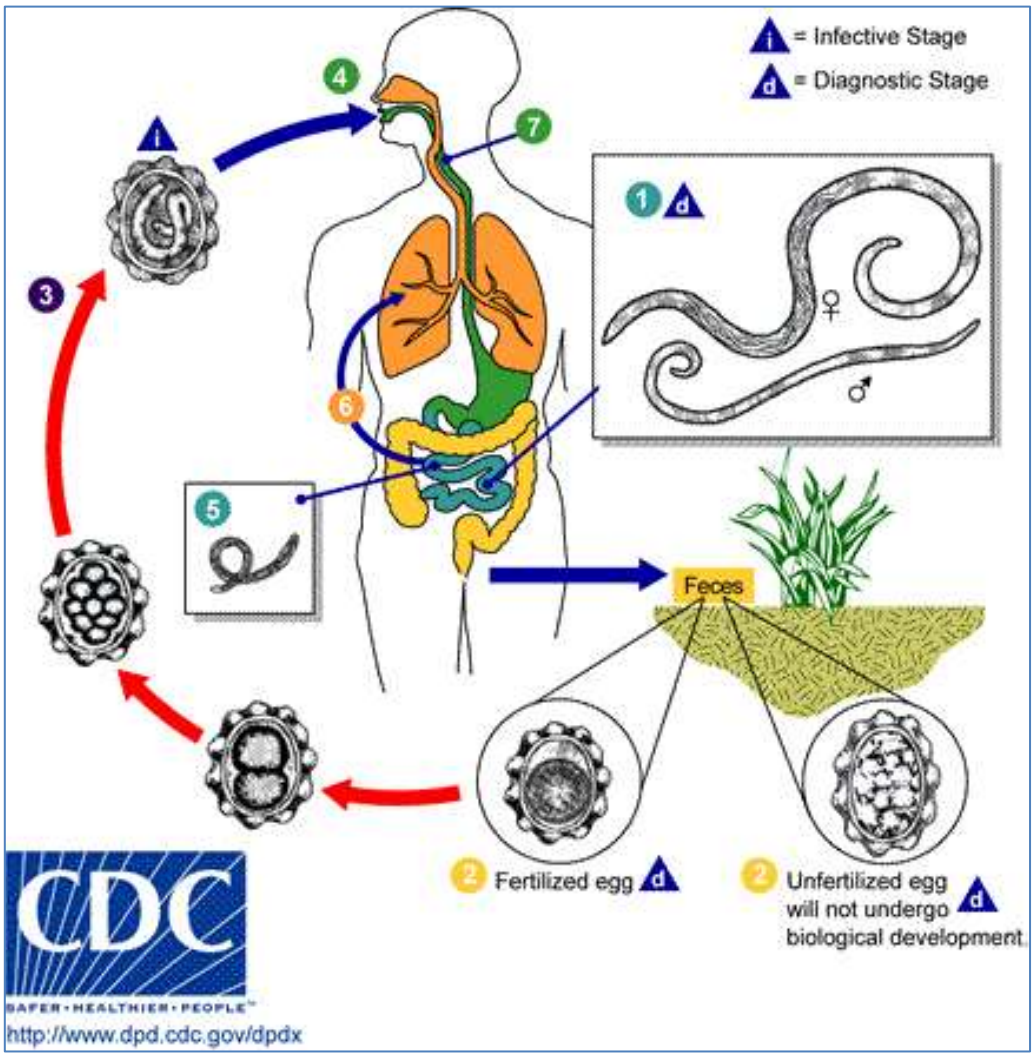

Figure 6 Lifecycle of A. lumbroides (CDC, 2012)

People infected with *Ascaris* often show no symptoms. At the larvael stage, symptoms similar to asthma or pneumonia may occur, such as persistent coughing, wheezing, or shortness of breath (Mayo Clinic, 2012). Mild or moderate ascariasis can cause vague abdominal pain, nausea and vomiting and diarrhoea or bloody stools (Mayo Clinic, 2012). A heavy infestation can cause severe abdominal pain, fatigue, vomiting, weight loss. A worm may be found in vomit or a stool, or may come out of the mouth or nostrils. (Mayo Clinic, 2012).

Diagnosis is usually made from the presence of eggs in stools, which may begin to appear 40 days after infection (Mayo Clinic, 2012). Because *A. lumbricoides* eggs bond to soil particles, which may be

filtered out in standard analytical procedures, prevalence is probably significantly underestimated (Buckley et al, 2008b). Some researchers (Mikhize-Kwitshana et al, 2011, Adams et al, 2006) have challenged the reliability of diagnosis exclusively on the basis of the presence in eggs in stools on the basis that helminthic infections produce different phenotypic outcomes characterised by specific immune responses. Mkhize-Kwitshana et al (2011) found that of 42 individuals with A. lumbricoides infections detected by the presence of elevated Ascaris-specific serum IgA, eggs were detected in the stools of only 21 individuals. Adams et al (2006) reported eggs found in stools for only a third to a half of individuals who exhibited an immune response to *A. lumbricoides*: in one study involving 41 women, 51.2% had elevated *Ascaris*-specific IgE while only 26.3% had eggs in faeces from multiple stool samples; in another study involving 359 children, 48% showed an immune response to *A. lumbricoides* while only 15% had eggs in faeces from two stool samples. Individuals who have ingested *A. lumbricoides* eggs which have not yet matured into reproducing female worms could exhibit immune responses without the presence of eggs in stools (Archer, pers. comm., 18 January 2013). In addition, in the case of an infection where all worms are male, no eggs would be found in the stool (Mayo Clinic, 2012). Diagnosis of *A. lumbricoides* can also be made by testing for an increase in the white blood cell eosinophils; however if elevated levels are found they could be due to other health conditions (Mayo Clinic, 2012). Treatment by Albendazole, Mebendazole, pyrantel pamoate is effective (Legesse, Erko and Medhin (2004).

Infections with *A. lumbricoides* are highly aggregated, with most infected individuals harbouring light infections and heavy infections occurring among only a small number of infected individuals (Jia, 2012). The effects of ascariasis can be serious, however. Children may experience loss of appetite and insufficient absorption of nutrients, resulting in nutritional deficiencies (Mayo Clinic, 2012). Blockages by masses of worms can perforate the intestinal wall or appendix, resulting in internal bleeding, or worms may block the ducts of the liver or pancreas, causing severe pain. In some cases, surgery may be required to remove worms to repair damaged tissue (ibid).

Figure 7 A section of intestine, blocked by *A. lumbricoides*, which was surgically removed from a 3-year-old boy at Red Cross Children's Hospital in Cape Town. The child survived. (Photo: Allen Jefthas in MRC, 2006)

Some research has explored the relationship between helminthiasis and HIV infection. Helminthiasis can lead to an imbalanced anti-viral response (down-regulated type 1 reaction), while long-term non-progression of HIV has been associated with a balanced anti-viral type 1/type 2 response; there may be increased transmission of HIV to infants when the maternal immune response is unbalanced (Adams et al, 2006). Some researchers have theorised that resistance to HIV and other illnesses may be impaired and HIV may progress to AIDS more quickly where sustained exposure to pathogens results in a strong type 2 response (ibid). In a study conducted by Mkhize-Kwitshana et al (2011) involving 124 individuals co-infected with HIV and *A. lumbricoides*, individuals showed a better immune response to HIV where *A. lumbricoides*-specific serum IgE was low, while individuals with elevated *A. lumbricoides*-specific IgE showed higher viral loads and lower CD4 counts. Adams et al (2006) reports that the immune profiles of children harbouring *A. lumbricoides* infections have been found to be polarised towards type 2; this profile has been associated with an impaired response to the cholera vaccine. A weak type 2 immune response profile has been associated with susceptibility to A. lumbricoides infection; while in individuals over 11 years of old, a strong type 2 profile has been associated with greater resistance to infection by *A. lumbricoides* (Adams et al, 2006).

In the environment, hardy *A. lumbricoides* eggs bond to particles of soil and are not easily washed away and prokaryotic biofilms are known to attach strongly to surfaces. Eggs fall into the size range of fine sand particles and in the soil may be more likely to move laterally with wind or rain than percolate downward ((Appleton and Gouws, 1996).

Trichuris trichiura

It was estimated in 2002 that 1 billion people were infected with *T. Trichiura* worldwide (CDC, 2012). Its prevalence may be as high as 95% among children in some parts of the world (Stephenson, 2000).

The eggs of *T. trichiura* pass with the stool. In the soil, they develop first into a 2-cell stage and then an advanced cleavage stage after which they embryonate, requiring 15 to 30 days to become infected (CDC, 2012). After ingestion, larvae hatch in the small intestine. Adult worms, which are approximately 4cm in length, establish themselves in the cecum and ascending colon by threading their anterior portions into the mucosa (CDC, 2012). Females begin to produce eggs 60 to 70 days after ingestion of fertile eggs and produce between 3,000 and 20,000 eggs per day (CDC, 2012). The life span of *T trichiura* is approximately 1 year.

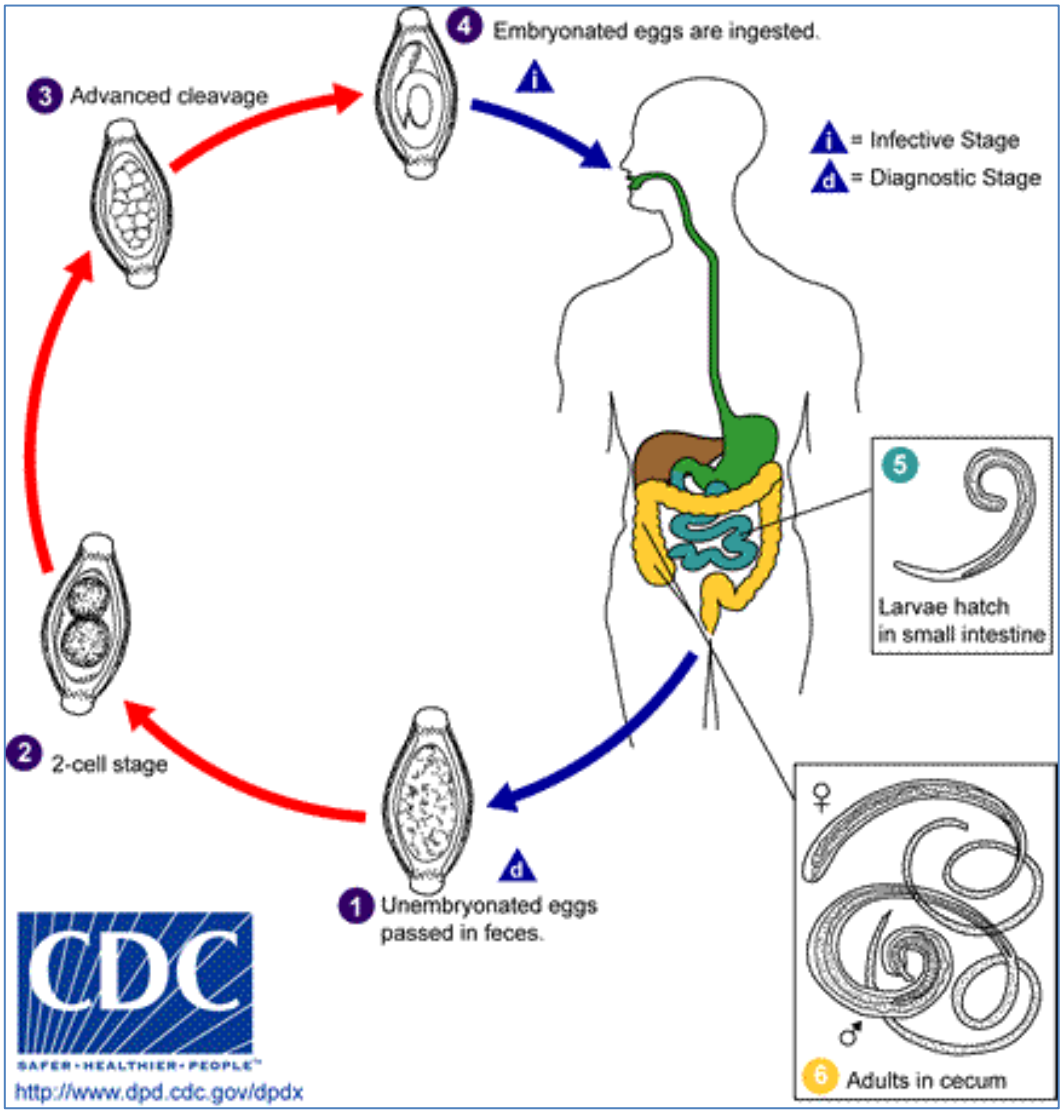

Figure 8 Lifecycle of *T. Trichiura* (CDC, 2012)

As with *A. lumbricoides*, only a small number of infected individuals suffer from heavy infections (Jia, 2012). Light infections are often asymptomic, while heavy infections can cause frequent, painful passage of stool which contains mucus, water, and blood. Heavy infections may result in Trichuris

Dysentery Syndrome (TDS) which may cause chronic dysentery, rectal prolapse, anaemia, poor growth, and clubbing of the fingers (Stephenson, 2000). Children, in particular, with heavy infections can become severely anemic and growth-retarded. While growth stunting has been reversed by oral iron therapy combined with repeated chemotherapy to treat infections, developmental and cognitive deficits resulting from TDS may be irreversible without significant psychosocial interventions. (Stephenson, 2000). The efficacy of chemotherapy treatments available has been variable and in some cases unsatisfactory.

Taenia spp

Eggs enter the environment when they are passed with faeces and can survive for an extended period of time outside of a host. Cattle (in the case of *T. saginata*) and pigs (in the case of *T. solium*) become infected by ingesting contaminated vegetation. In the animal's intestine, the oncospheres hatch, migrate into the muscle and develop into cysticerci. Humans consuming meat containing cysticerci which has not been cooked adequately may become infected. *T. solium* can also be passed person to person by ingesting eggs that are present on hands, surfaces, food or soil contaminated with faecal matter containing viable eggs or proglottids (Carabin, 2006). In the human host, the cysticercus reaches adulthood in two months in the intestine where it attaches by its scolex. Worms can reach a length of 5 to 7m; worms as long as 25m have been documented. Proglottids containing as many as 50 000 (*T. solium*) to 100 000 (*T. saginata*) eggs detach from the worm and are passed with the faeces (CDC, 2012).

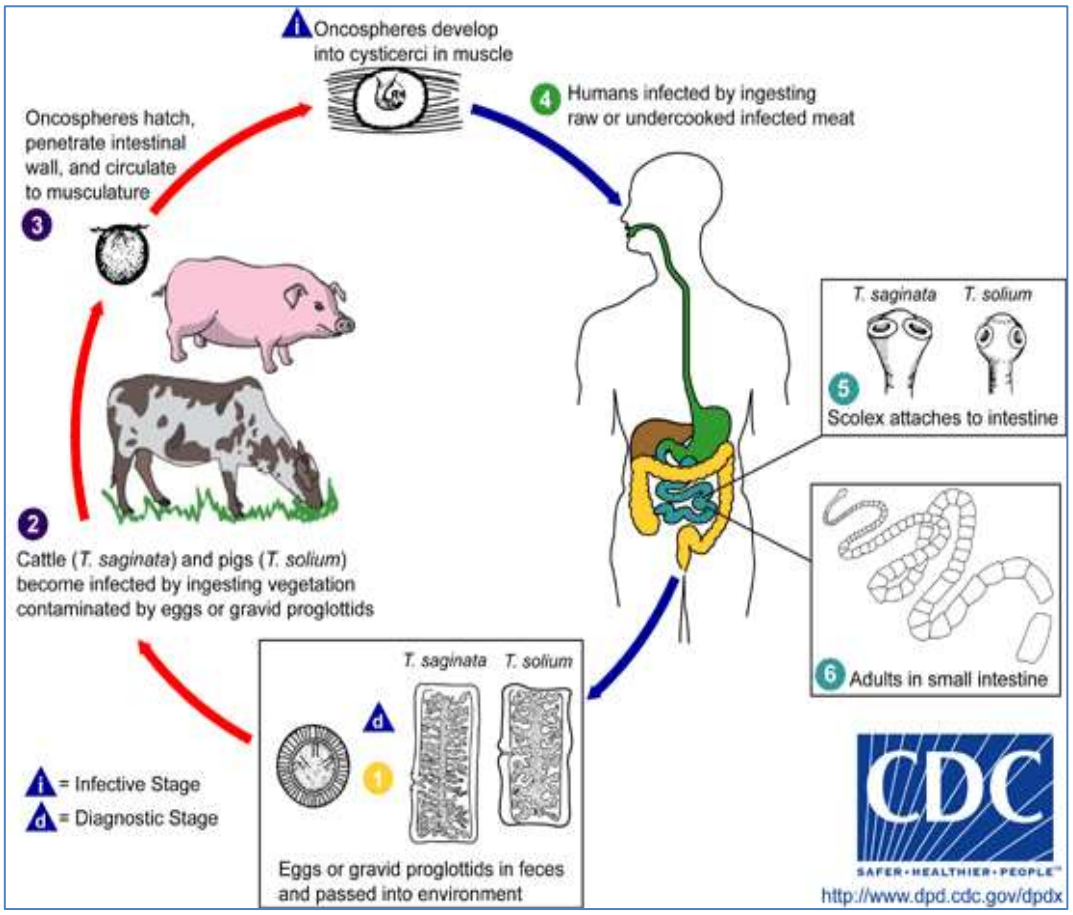

Figure 9 Lifecycle of Taenia spp (CDC, 2012)

In the human host, cysts may lodge in any organ of the body, but brain involvement resulting in neurocysticercosis (NCC) is the most common cause of disease (Carabin et al, 2006). Seizures occur in 66–90% of patients with NCC; other central nervous system manifestations can occur as well, however (ibid). In severe cases, NCC can be fatal (ibid).

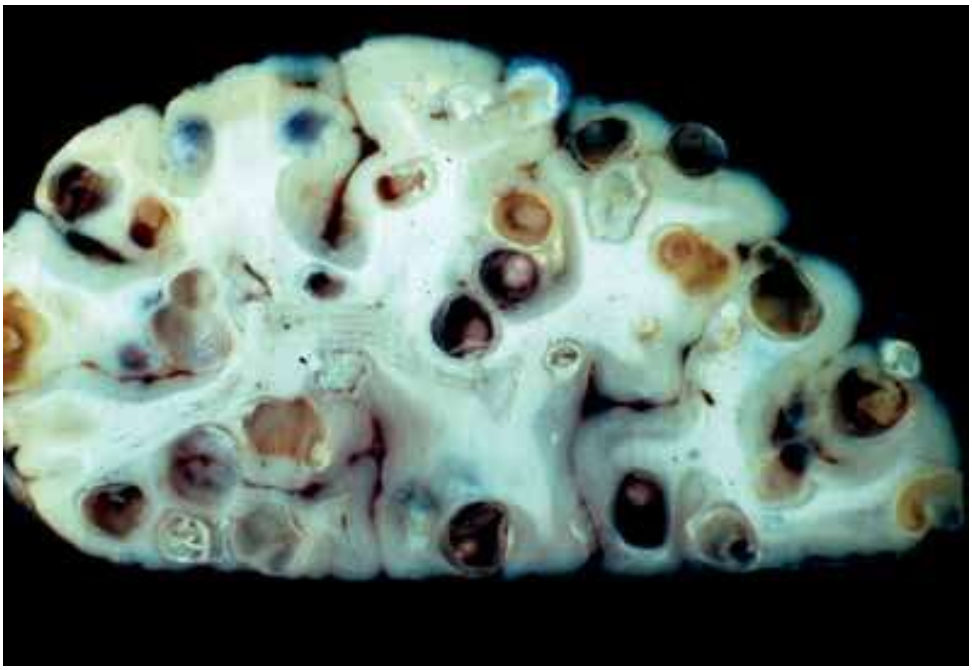

Figure 10 A portion of a human brain containing numerous T. solium cysts (Photo: Photo: Dr T. Nash in MRC 2006)

A higher burden of disease resulting from *T. solium* has been documented in the Eastern Cape in South Africa for decades, with a 1965 study suggesting that cerebral cysticercosis was twice as high among people in that area than among other groups or regions in the country (Mafojane et al, 2003). In a 2004 study, 76% of respondents reported having seen cysts in the pork that they ate, though only 80% of these knew what the cysts were (Carabin et al, 2006). Mafojane et al (2003) reports the practice in the Eastern Cape of placing *T. solium* eggs into a lover's drink for revenge as well as the consumption of eggs as a treatment for severe infections of *T solium*.

3.3.3 Treatment and prevention

In 1998, the KwaZulu-Natal Department of Health initiated a pilot programme to control helminthic infections through regular treatment of primary school children (Saathoff et al, 2004). Unfortunately this initiative did not materialise into an ongoing programme. South African hospitals typically administer single dose antihelminthic treatment to all children seen at the hospital; this however does not achieve the comprehensive treatment of children which school-based programmes would (Bishop, pers. comm., 2013). Without comprehensive, sustained chemotherapy treatment in areas where helminths are endemic, reinfection is probable. Appleton et al (2008) found that among children in a Durban slum infection with *A. lumbricoides* reached the same intensity by one year after treatment as it was pre-treatment, while for *T. trichiura* it was even higher. An analysis of 51 studies conducted by Jia et al (2012) confirmed this trend: for the three most common soil transmitted helminths (*A. lumbricoides*, *T. trichiura* and hookworm) after treatment prevalence of

infection reached half of what it had been pretreatment in 6 months, and a year after treatment levels of infection had usually returned to levels close to the pretreatment figures.

A review of deworming programmes which are currently being implemented in South Africa is underway.

Tronnberg et al (2010) found that in two rural communities in KwaZulu-Natal the provision of UD toilets and health education was associated with a 41% reduction of diarrhoea episodes but the prevalence of parasitic infections among these families remained high: in sludge samples from 120 UD toilets the most prevalent helminths were found to be *A. lumbricoides* (59%), *T. trichiura* (48%) and *Taenia spp* (18%), while *G. intestinalis* (54%) and *Cryptosporidium spp* (21%) were the most prevalent protozoans.

In 2001, the World Health Assembly passed a resolution urging member states to implement antihelminthic drug campaigns to reduce morbidity among school-aged children (Bethony, 2006).

3.4 Anecdotal accounts

The following information was gathered from informal interviews and discussions conducted during September 2014.

3.4.1 KwaZulu-Natal

Helminths

All intestinal worms were referred to by respondents as *izikelemu;* no distinctive names were used for different kinds of worms. Many had witnessed worms exiting the body through the anus, mouth, nose, ears or eyes. The following descriptions of worms were provided:

- look like spaghetti
- long and white
- long, with a head that is visible
- as long as an earthworm but thinner, whitish and with a red head sometimes full of blood
- maggots
- a few centimetres long
- ant-sized, shaped like rice
- brown, looks like a small snake

The sangoma described small worms that exit from the anus (pinworm); she believed that these worms hatch in the stomach and then try to exit the body from the anus.

Many respondents reported that they didn't know how a person gets worms in their body. The following ways were reported that one could get worms:

- Eating sour milk (maas) – this was the most common reason given
- Bacteria on your hands

- Bacteria transferred while someone is coughing
- Eating food off of the floor
- Flies sitting on food
- Eating meat that isn't well cooked

Respondents indicated the following impacts that worms can have on the body:

- cause pain from biting you
- eats your stomach
- stomach ache
- blood in stools
- children cry a lot
- no appetite
- fever
- vomiting
- unable to gain weight
- always hungry
- can kill you
- eat your food
- itchy anus
- grinding teeth while sleeping
- no symptoms

Treatment for worms

Nearly all respondents indicated that one should take a pill obtained from the clinic or chemist to get rid of worms. Some reported seeing worms, some alive and dead, come out of their anuses after taking a deworming tablet. The sangoma indicated that she prepares a mixture to be taken for worms. She asks the patient to wait until the medication causes the worms to be expelled and she sees them come out.

Diarrhoea

Respondents indicated the following ways by which diarrhoeal diseases could be contracted:

- Drinking water from the river
- Not washing hands after using the loo
- Eating bad food
- Eating food which has been contaminated by flies

The sangoma said that most people with diarrhoea go to the clinic these days, rather than coming to her for help.

Respondents indicated the following actions that could be taken to prevent diarrhoea:

- Drink clean water
- Boil all water collected from the river
- Wash hands after using loo
- wash hands often
- wash food
- cover food always to prevent flies from contaminating it

3.4.2 Eastern Cape

Helminths

There was a general awareness that helminths were harmful but respondents did not have much knowledge about them. When asked how people get worms in their bodies, most believed that it was from eating sweet things, while another believed that worms could be caused by a curse from a sangoma. One said they eat nutrients and minerals that should be eaten by body cells. They cause stomach cramps and make a person feel hungry all the time. Worms were described as looking like snakes, being brownish like earthworms, or being whitish. One had seen worms coming out of someone and said it was disgusting and they didn't want to talk about it; another laughed, saying that it had been funny. One said their parents had said worms are dangerous and that they can come out of your nose or mouth and you can die. When asked how you could get rid of worms, responses included drinking Krakrayo (a homemade mixture of camphor crystals and aloe) and getting a treatment from a sangoma. When asked how you could protect yourself from getting worms, responses included not eating sweet things and cleaning your stomach once a month (no indication was given of how this was done.) Most did not think that babies playing outside in the soil could eat worm eggs or that people who eat soil could accidentally eat worm eggs.

Diarrhoea

When asked what causes diarrhoea, responses included too much meat and eating expired food. When asked how one could treat diarrhoea, responses included making and administering an oral rehydration solution to children 3 times a day, giving the sick person clean water and buying medicine.

4. GEOPHAGIA

While the literature on the practice of geophagia is slim, what literature exists demonstrates that the practice is widespread. Woywodt and Kiss (2002) report a high prevalence of geophagia in South Africa and many other regions of the world. Preferred soils which have been documented include white and red clays, earthworm castings and anthills. Reasons put forward for geophagia around the world are extremely varied, ranging from accounts of geophagia associated with psychiatric illness, famine or aenemia, to consumption of soil to lighten or soften the skin (Woywodt and Kiss, 2002). In *Geophagical Customs*, a global study produced in 1958, Swedish researchers Anell and Lagerkrantz documented views of soil as a spice or delicacy, as a medicine able to cure syphilis and diarrhoea, as an article consumed during rituals and as a substance which criminals are forced to eat to administer justice (Bartas & Ekman, 2001). Starks and Slabach (2012) state that in Africa individuals with calcium deficiency practice geophagia more often than those with ready access to calcium, and suggest that the need for calcium might account for the behaviour most commonly being reported among pregnant women, while clays in particular may serve a role as detoxifier for some animals and also, possibly, for humans. Cases of addiction to soil and sometimes bizarre accounts have been reported.

In South Africa, geophagia is not well documented and information is possibly not offered freely. Woywodt and Kiss (2002) believe that frequently those practicing the behaviour conceal it from doctors, with the result that it is not widely recognised. A study conducted by George and Ndip (2011) in the rural Oliver Tambo district of the Eastern Cape found that 75% of the 240 women interviewed practiced, or had practiced, geophagia. George and Ndip (2011) found that while for 75% of respondents the behaviour was known to friends and relatives, it was practiced somewhat secretly, which would also account for underreporting. Both rural and urban, and educated and illiterate, women reported consuming soil, with some reporting that they consumed soil more than once daily. Geophagic soils were not commercially available in the area and were collected from the home garden or elsewhere.

A study published by Berridge in 2010 attempted to characterize human geophagic habits and the microbiological content of geophagic soils, including the presence of potentially pathogenic nematodes, in the Thabo Mofutsanyae District of the Free State. The study revealed that geophagia in this region was practised mainly by women of child-bearing age. The reason given by users for practicing geophagia was the pleasant taste of the soil. Geophagic soils, known locally as *mobu*, were clayey and ranged in colour from brownish to greyish and yellowish, with a whitish clayey soil reported to be most favoured by users. Soil was collected from the mountain- and riversides with some consideration of hygiene and environmental and was sold by vendors for R1-2 per bag.

A study conducted in rural KwaZulu-Natal among school children (median age 11) found that 53% of girls and 37% of boys practiced geophagia; the practice decreased with age for boys but not for girls and was more common among children from families of higher socio-economic status (Saathoff et al, 2002). During interviews conducted by PID with learners at a primary school in May 2013, 4 of 10 respondents reported that a friend or family member regularly practiced geophagia, including a description of some girls at the school regularly consuming soil from a particular place on the school grounds (unpublished data).

Risk of infection with pathogens

While it remains unclear whether geophagia of particular soils may have nutritive or other beneficial properties, those consuming soil from around households or other areas which could be faecally contaminated could place themselves at risk for helminthic infections or diarrhoeal diseases. A study involving 208 school children in Kenya found that 77% of the children practiced geophagia daily and 48% of all soil samples were contaminated with eggs of *Ascaris lumbricoides*; 14% of participants were infected with *Ascaris lumbricoides* and 43% with *Trichuris trichiura* (Geissler et al, 1998). Re-infection with *Ascaris lumbricoides* was twice as common among children who practiced geophagia than among those who did not; in addition, the intensity of reinfections was higher among geophageous children. A study in Guinea found that geophagia was reported by parents to occur in 57% of children ages 1-5, 53% of children ages 6-10 and 43% of children ages 11-18; 53% of the children in the study were infected by at least one type of soil-transmitted nematode (Glickman et al, 1999). The infection pattern for helminths acquired orally (*A. lumbricoides, T. trichiura*) matched the pattern of geophagia more closely than did infections acquired through the skin.

In South Africa, a study involving 52 geophagic soil samples from Thabo Mofutsanyane District in Free Sate found no pathogenic nematode ova or larvae in the samples, although 34 nonpathogenic nematode taxa were identified in the samples (Perridge, 2010). A study by William et al (2009) conducted in Kenya investigating whether geophagia practiced by children in the home environment poses a risk of diarrhoeal disease, outlines vulnerability of children under the age of 5 to environmental health risks that lead to diseases such as diarrhoea and intestinal worms. The study found that fewer incidents of diarrhoea were reported by respondents who ingested minimal amounts of soil or did not practice geophagia at all, with the highest incidence of diarrhoea reported among those who ate significant amounts of soil. In this study, the types of toilets used by households where there was occasional or a lot of soil ingestion by children ranged from VIP to simple pit with cement floor, simple pit with wood floor, simple pit with earth floor or no toilet facility at all. The study concluded that geophagia in the home environment is a risk factor for diarrhoea among children in that community.

While geophagia is clearly a potential risk factor for acquiring helminthic infections in the context of open defecation, a lack of sound knowledge regarding the epidemiology of helminths and the treatment and prevention of helminthic infections is a serious barrier to overcoming this. In the Eastern Cape where tapeworm infection is a particular problem, resulting in cysts forming in the brains of infected individuals which can cause epilepsy, Mathews, Mammen and Mammen (2012) found that among Xhosa students at Walter Sisulu University 40% had scientifically incorrect beliefs about taeniasis (tapeworm infection), 77% had incorrect beliefs about cysticercosis and 38% had incorrect beliefs about the cause of epilepsy, with 23% believing that epilepsy was the result of visits from ancestors or spirits. In a 2004 study in the same area, 76% of respondents reported having seen cysts in the pork that they ate, although only 80% of these knew what the cysts were (Carabin et al, 2006). Mafojane et al (2003) reports the practices in the Eastern Cape of placing *Taenia solium* eggs into a lover's drink for revenge as well as the consumption of eggs as a treatment for severe infections of *T. solium*. During the survey of school learners by Partners in Development described above, the 22 learners and 6 staff interviewed demonstrated an extremely low level of knowledge around how helminthic infections are contracted and their impact on health. When asked how you could get a worm infection, only 23% of learners gave a response which related to hygiene or soil,

while 50% said they had no idea and others attributed worm infections to eating cheese, sugar or maas, drinking from the taps in the loo or sitting on the toilet too long. When asked what worms could do to you, the majority (55%) said they didn't know, while 37% said that they could make you sick but were unable to describe any symptoms and 10% (2) said that they eat your food. When asked what you could do to get rid of worms, 68% said that you could go to a clinic or pharmacy for medicine, 18% said they had no idea, and a few offered ideas such as taking castor oil and washing your body daily with Dettol.

4.1 Anecdotal accounts from target regions

The following information was gathered from informal interviews and discussions conducted during September 2014.

4.1.1 KwaZulu-Natal

Prevalence

All of the respondents were able to report family, neighbours or friends who practice geophagia, while some of them practiced it themselves. Women, men and children were reported to practice geophagia, with the practice reported as far more common among women than men although there was no indication that the practice carries any sort of a social sigma for either women or men. One respondent estimated that 40% of the women she knows, 10% of the children and none of the men practice geophagia. Another respondent indicated that she believed that 90% of women practice geophagia but that no men do. While she said children do not practice geophagia this may indicate that the similarity between the behaviours of adults eating specific geophagic soils and children putting soil from the household environment into their mouths may not be apparent to all respondents and questions should be designed to address these two groups separately.

Different soil types

Two main geophagic soils were described which are called *ibovu* and *ukhetho* in Zulu.

Ibovu is a red soil which is collected locally from exposed banks and boiled with water to form a paste which is then moulded into balls by vendors, although it appears it is widely available and often collected directly from the environment by those who use it and eaten as is. It was available in the CBD of Pietermaritzburg at R10 for a ball the size of an orange. In addition to being eaten, *ibovu* is also used topically as a sunscreen. It is also used by sangomas in a ceremony in which an infant is given a herbal mixture to drink which is believed to give the child protection from diseases. *Ibovu* is not ingested in this ritual but is smeared on the outside of the clay pot containing the medicine and is considered to be responsible for activating the protective properties of the mixture inside the pot. *Ibovu* is also mixed with herbs to create a potion to chase away evil spirits. It was also reported that *ibovu* can be applied to a wound or cut to "dry it up" or to acne, for the same reason.

Figure 1 Site where ibovu is collected at a household for consumption

Figure 2 Ibovu (red) and umnchako (white) sold together in the Pietermaritzburg CBD

Ukhetho is a material which appears to be rocky but is soft and can easily be crumbled. It is typically light brown but its colour can vary from creamy to dark brown. One respondent indicated that it is collected locally from quarries while others reported collecting it near rivers or along main roads and others obtained it from embankment on their household premises. It is broken into smaller pieces for sale and was available in large pieces or in small pieces sold in a small packet for R6 in the

Pietermaritzburg CBD. It is not prepared in any way other than scraping off any loose soil if it is collected directly.

Figure 11 Ukhetho sold alongside impepho in the Pietermaritzburg CBD

One respondent from rural northern KwaZulu-Natal reported that the soil from termite heaps, sometimes collected from the sides of walls, as well as a brownish clay taken directly from the ground were popular geophagic soils in his community. Both were eaten for their taste and he was unaware of any other benefits; the termite soil in particular was known for its appealing smell, particularly after being wetted by rain.

In addition to specific geophagic practices associated with these 3 soils, a number of respondents mentioned geophagia associated with short rainfalls ("the 5 minute rain") where the wetting of the soil (or possibly the effect of nitrogen brought down to the soil by the rain?) releases a distinct odour from the soil. Respondents said that when this happens many people who practice geophagia feel a compelling desire to find soil to eat. It is unclear to what extent they may eat other soils available in their immediate environment if their preferred soil is not available. This aspect should be further investigated.

There is also a white soil called *umnchako* which was mentioned by respondents and was available in the market, sometimes sold together with balls of *ukhetho.* It is used topically by initiates (*ukuthwasa*) to indicate that they are in the final stages of training to be a *sangoma*; it is also mixed with impepho, a plant that is burned during initiation ceremonies. It is collected from river banks, mixed with water and moulded into balls which may be mixed together with balls of *ukhetho* in the market. There were no reports of this soil being eaten; however the sangoma indicated that small quantities are sometimes mixed into medicines. It is also used in preparations for spells.

It was mentioned by one respondent that chalk is eaten by some children at school.

Figure 12 Umnchako (white balls) and ibovu (red balls) sold at a traditional chemist in the Pietermaritzburg CBD

Practices

None of the respondents had information regarding geophagia practiced in the past as reported by grandparents or parents. A number of respondents indicated that grandparents or parents advised them not to eat soil because it was dangerous, although it did not appear that this was a significant deterrent. While many reported disapproval among family members around addiction to soil, it was always reported to be eaten openly. One respondent indicated that while she eats it several times a day she does not think that anyone should be eating it and her brother frequently tells her it is not a safe practice. Another respondent said that while her sister was addicted to *ibovu* her mother and grandmother opposed it and her sister's partner would sometimes throw it away so that she couldn't eat it.

Informants reported sometimes collecting *ibovu* from areas where cows are ranging or along thoroughfares. Several collected soils from their household premises; either from exposed embankments or from the ground. One informant indicated that it was collected from near the toilet at home; another from an area where young children play. A number of respondents indicated that soil was collected along pathways where people walk. One said it was collected along a path where men sometimes urinate. Sometimes the top soil is scraped away in order to collect the cleaner soil beneath.

The reported frequency of eating soil ranged from occasional to daily to as often as four times per day. One said she mostly eats it when it rains. While the teenage boy indicated that he eats ukhetho every day -- usually when he gets home from school – he mentioned that his male friend, with whom he sometimes shares it, eats it less frequently. He drinks water while eating it to wash it down. He experiences a sense of craving before eating it which is satisfied after eating it. He reported knowing another person who was addicted to *ukhetho* and needed to eat it every day. A female respondent mentioned that she knows a woman who gets depressed and locks herself into

her room; if she is able to go and collect *ukhetho* her mood improves and she becomes more energetic.

A few respondents likened geophagia to smoking in that those who get addicted need to consume it repeatedly throughout the day and that those who practice geophagia seek each other out and like to share geophagic soils or consume them together. One respondent indicated that girls often take soil to school to eat because they may not be able to find it there and also because they want to eat it with their friends. Similarly, some women bring it to work to eat after lunch. One respondent indicated that if a person addicted to geophagia cannot find her preferred soil when craving it, she may go up to someone smoking a cigarette and ask the person to tap some ash into her hand, which she will then eat.

Motivation

Reasons given for eating *ibovu* were its pleasant taste, to supply iron, to moderate low blood pressure and for the satisfaction that it provides, particularly to those who are addicted to it. Informants reported that some women first develop a craving for *ibovu* while they are pregnant but the habit of eating it for some continues after the pregnancy.

Several respondents indicated that *ukhetho* is eaten simply because it is delicious – one noting that she enjoys the sourness of the taste. However it was noted that pregnant women, as well as individuals with iron deficiency, are often attracted to it. Another informant reported that some people are told to eat it by their ancestors and that it plays a role in the first stage of initiation into becoming a *sangoma*.

Two informants, a male and a female, indicated that they first tried eating soil as children when they saw female relatives eating it. Some people are reported to experience a strong craving for it if they pass by an area where it is visible. One respondent said that her sister, who is addicted to it, can even smell it if it is in another room and begin to crave it. Another reported waking up in the night craving it and feeling satisfied after eating it, while another reported her sister taking it to bed with her and eating it before she falls asleep. Informants reported that after eating it an addicted person feels calmer and that concentration is improved. The teenaged male respondent indicated that he eats *ukhetho* when he feels bored.

Health implications

Informants reported that eating *ibovu* can make you thirsty and give you abdominal pain. Constipation was frequently reported, although one respondent said that *ukhetho* sometimes causes diarrhoea. Several people reported that people that they know who eat soil had developed appendicitis and had to have their appendix removed. Others had to have operations to remove "stones" which had collected in their stomachs. Another informant reported a woman who had frequent stomach cramps which were believed to result from her habit of eating *ukhetho*; she eventually had to have an operation. She believed that you can die of complications if you eat soil habitually. He said that elders commonly warned that practicing geophagia could result in blocked reproductive passages in women. As mentioned above, some respondents indicated that the top soil is removed before collecting the soil to avoid contamination.

Several respondents believed that it is not healthy for anyone to eat it, particularly children. One informant reported that it causes stones in the stomach, appendicitis and constipation. One respondent said that she believed it was dangerous for pregnant women to eat *ukhetho*; another said that she believed that eating soil can cause problems in the womb. One informant reported that nurses sometimes tell pregnant women to eat cake after eating soil.

In addition to In interviews with staff at a school in May 2013, one respondent described to Partners in Development staff that a member of her family buys and eats a white rock called "white wash" every day; if she is not able to obtain this she breaks off pieces of a crumbling wattle and daub house nearby and eats them. A PID employee also reported witnessing women collecting soil to eat from an area used by male patrons of a tavern to urinate.

4.1.2 Limpopo/Gauteng

The following information was gathered from soil suppliers, vendors and users at Marabastad Station in Pretoria as well as from one householder.

Soil supplier

A male supplier who was delivering bags of soil to vendors at Marabastad Station in Pretoria was interviewed (after a lot of convincing). He was reluctant to participate and was suspicious of the interview, probably thinking the interviewer was from government or a competitor. Of particular concern was his business as he pointed out he was in a rush to complete the delivery.

The supplier indicated the following:

- He sells blocks of red soil in 10 kilograms bags at an undisclosed amount to vendors who are his regular customers.
- He also does not know what the soil name is. He buys it from different places in Pretoria and believes it is dug in the surrounding mountains.
- Although not wanting to divulge more information, the supplier indicated that he believes pregnant women (making up 90% of the users) like eating soil.
- The soil is sold to suppliers as is. It is not prepared in any way. The supplier indicated he thinks the soil relieves stress.
- He believes it has nutrients or other special benefits, hence the huge demand for it.
- There are many people who are addicted to soil ingestion and crave a lot for it. He believes there are people who cannot sleep if they have not eaten soil.
- He also thinks that the sick should not eat soil.

Soil vendors

Generally, the vendors did not seem knowledgeable about the soil they are selling. The soil is not known by any particular name. It is just called soil, only differentiated by colour which seems to be the only identifier and distinctive feature. They provided the following details:

- Vendors buy huge slabs from local suppliers at undisclosed amounts. In terms of preparation, no other substance is added. They only pour water over them, and then dry

them in the sun. These slabs are later cut into small blocks of both red and brown pieces of compacted soil. They then sell the soil at R5 per packaged blocks and R1 for a single small block. The vendors do not weigh the soil when packaging.

- Their customers are mostly women, particularly pregnant women who like the brown one. There are apparently men who buy and discreetly eat the soil, although it seems shameful for men to eat soil. Because of this, they (men) buy under false pretences, indicating that it is for their women (Wives, partners, girlfriends).
- The two vendors did not know what the soil is used for, neither do they eat it. Although one of them (woman vendor who once ate soil) indicated she used to eat soil when pregnant and derived no benefits as she only craved for it. She indicated that regular users say the soil is good.
- According to the two vendors, some of their customers indicate that they feel good after eating the soil.
- In terms of benefits, there are people who claim that soil helps with constipation problems as it cleans the stomach (acts as a laxative). There is also a claim that brown soil works as a contraceptive.
- The vendors are not aware of any possibility of danger or risk associated with eating soil.
- The woman vendor indicated that some people who are sick eat soil the most as they claim that they cannot sleep without consuming it.
- The vendors indicated that there are people who are addicted as they buy a number of times per day, 2 to 4 packets per day. One of the vendors (woman vendor) indicated some people buy and eat the soil with colleagues at work.
- There are customers who claim that the ingestible soil is eaten like “pap” in Mozambique where people grind it, add salt and sell it in powder form.

Figure 13 Brownish geophagic soil sold by vendors in Pretoria

Figure 14 Yellow and red geophagic soils sold by vendors in Pretoria

Users

Three users of geophagic soils were interviewed and their responses were mixed and varied from eating the soil to feel good to addiction. Below are the summarised responses from the 3 users.

In terms of preference, one user prefers red soil while the other 2 prefer brown. They all buy from the two interviewed local vendors. They don't know any other name of the soil they consume except that it is soil. Two respondents indicated they eat it as is (no substances or liquids added) while one respondent indicated she crushes the small blocks and eat dust. The three respondents indicated they buy soil at R1 per unit (1 piece) and R5 for a packet.

- The 3 users do not know where the soil is collected from and have no particular reason for eating soil. All they know is that they feel good after eating the soil but would not advise anyone to get into the habit.
- The respondents agreed that women like and enjoy eating soil out of addiction. Two indicated that they do not know if soil is good for anyone while one respondent indicated that she thinks soil could be good for the sick.
- The types of benefits that some believe are derived from soil are stress relief. One respondent pointed out that the elders used to encourage them to give soil to children as it

was believed that it strengthens the spinal cord. One of the respondents indicated she does not believe soil has any benefits and soil ingestion is not good for anyone.

- All respondents agreed that the habit of eating soil is not good as it is blocks the intestines and also causes appendix problems. One of the respondents confirmed that she was told to stop eating soil at the local clinic, and she knows someone who had to be operated on because of soil ingestion addiction. One respondent believes soil ingestion is bad for pregnant women as it could affect the baby's skin. She also believes soil ingestion could kill someone. She saw people in hospital with swollen stomachs who were due to be operated. She also believes that eating soil poses a huge risk to one's health.
- All 3 respondents indicated the soil never made them sick. To address constipation and bloating caused by soil ingestion, some indicated they drink fresh milk.
- Two respondents indicated that they cannot stop the habit of eating soil because they are addicted. Only one respondent indicated that she is not addicted as she can only eat one piece of soil a month.
- One respondent highlighted that as far as she knows, the soil does not help with anything. She indicated she consulted the doctor when she was pregnant and was advised to stop eating soil as it affects her blood. She also indicated that her husband has tried getting her to stop eating soil but she could not. The husband was concerned about her health and the damage it causes such as blocking the toilet.

Observers

Two male observers who once ate soil indicated they do not understand why people eat soil as it is tasteless. They pointed out that soil ingestion habit is similar to cigarette smoking because it affects their health but they do not quit.

4.1.3 Eastern Cape

The following information was collected from informal interviews and discussions.

Different soil types

Three types of geophagic soil were mentioned. The most common was clayey garden soil; most people want the "clumpy bits that earthworms like" (perhaps earthworm castings?). Sandy soil was mentioned along with the soil from dirt roads, although this was considered least preferable. Red clay soil was also talked about.

Garden soil considered desirable for consumption was described as mud-like or clayey and formed in clumps. It is collected at the household or wherever it can be found. It is eaten for its pleasant taste; respondents reported being tempted by the smell of the soil after rains. It is eaten directly with no special preparation. Most respondents believed it was safe to eat this soil, with only one person mentioning stomach cramps as a possible negative effect.

Red clay soil is collected wherever it is found and is eaten directly, with no special preparation. One woman reported that a nurse at the clinic in Lady Frere advised her to eat soil when she was

pregnant as her haemoglobin was low. It seemed to help and she had no further problems during her pregnancy. Respondents believed it was safe to eat this soil. Teenage girls (ages 12-16) and pregnant women were considered to be the groups in which geophagia was most common.

Practices

Geophagia was associated with women; no one could give a case of a man eating it. Most people collect the soil from their gardens or around the village. Geophagia is usually practiced openly, whenever and wherever a person chooses to. One person mentioned that someone might practice the habit secretly if their parents have told them not to do it. Many said that their parents and grandparents had spoken to them about geophagia, speaking of how they liked the taste and the smell of soil and how it made you feel full.

In terms of addiction, a woman who started eating soil on the advice of a nurse was described as becoming addicted and is reported to now go to extreme lengths to get the right soil (from a particular field in Lady Frere) brought to her in Cape Town. One person said that pregnant women can become so addicted that they 'will kill you if they don't find it'.

Motivation

Soil is eaten mostly for its taste and to satisfy a craving, which can be brought on by the smell of wet soil or during pregnancy. One person described it as 'smelling so good you just want to eat it' another said it is 'smooth like chocolate'. Many of the teenage girls believe it will increase the size of their breasts, and for this reason it is eaten as well as sometimes applied to the nipples topically. Soil was not reported to be used for magical purposes or to cure illnesses, although the use of red clay soil to boost haemoglobin was mentioned.

Health implications

One said that some parents say it will give you a bad stomach and rotten teeth. Otherwise all said it was fully accepted. Generally it is believed that if earthworms were present in the soil it is clean enough to be eaten safely. While one person felt that children shouldn't eat soil as its dirty, most said that it is natural and common for children to eat soil.

5. HEALTH AND HYGIENE

The following outlines the review of literature and resources that is being undertaken by Bashomi.

5.1 Status of sanitation provision in South Africa

This section looks at the health threat posed by sanitation backlogs and the implications thereof (including the health effects and cost of poor sanitation). The global sanitation backlogs are unpacked in terms of access and lack of access to facilities. Environmental causes of diseases are looked at. The main causes of environmental related deaths in South Africa are discussed with reference to statistics released by Council for Scientific and Industrial Research (CSIR) and Statistics South Africa (Stats-SA). The costs of poor sanitation are discussed with specific reference to the Tanzanian government experience.

5.2 Legislation, policy and strategy

This section covers health and hygiene guiding and policy principles in South Africa. Focus is how the national environmental health policy helps address environmental health-related challenges and also how it guides implementation of environmental health services through various strategies. Objectives of the national health and hygiene strategy are looked at. The strategy is also discussed to give a perspective of the distinction between health and hygiene education and health and hygiene awareness as the two are often confused. The intended impact of these two is also pointed out. Institutional arrangements on the implementation of environmental health services as well as for implementation of health and hygiene education are discussed.

This section also looks at the 2008 Libreville Declaration on Health and Environment in Africa where various African countries including South Africa made commitments to strengthen health and environment institutions as a way of addressing environmental health challenges. The framework for the provision of both environmental health and health and hygiene education in South Africa is looked into to establish the country's approach to the provision of environmental health as well as health and hygiene education.

Key documents for review:

- Whitepaper on household sanitation – DWAF 2001
- Preliminary Draft Paper on the development of a sanitation policy and practice in south Africa, 2002
- National Sanitation Policy
- Final Draft of the National Sanitation Strategy – Department of Water Affairs and Forestry 2004
- National School Sanitation Strategy – Department of Education and DWAF, 2006
- Draft Communication Strategy for Sanitation Advocacy 2006/7 - Department of Water Affairs and Forestry
- 2008 International Year of Sanitation Presentation - National Sanitation Programme
- Handbook for facilitating development and governance responses to HIV and AIDS. MRC/INCA/DPLG, 2008

- Framework for a National Sanitation Strategy, DWAF 2008. http://www.dwaf.gov.za/dir_ws/content/lids/PDF/Strategy.pdf
- Integrated School Health Policy 2012, http://www.education.gov.za/LinkClick.aspx?fileticket=x7XUJxMcfvs%3D&tabid=870&mid=2453.
- National Environmental Health Policy – Department of Health, 2013
- National Health and Hygiene Education Strategy related to Water Supply and Sanitation Services
- Integrated Management of Childhood Illness Strategy http://www.education.gov.za/LinkClick.aspx?fileticket=x7XUJxMcfvs%3D&tabid=870&mid=2453
- DWAF Sanitation Questions and Answers on the White Paper on Basic Sanitation
- WHO strategy for the control of soil-transmitted helminth infections http://www.who.int/intestinal_worms/strategy/en/

Provision of health and hygiene education in South Africa is guided by the National Health and Hygiene Education Strategy which was developed in 2005 by the then Department of Water and Forestry in collaboration with the Department of Health. This strategy which places the Department of Health as the custodian of health and hygiene education, provides a framework to the water services sector role players for incorporation and implementation of health and hygiene education within the delivery of water and sanitation services. According to the National Health and Hygiene Education Strategy, health and hygiene promotion is also delivered to communities by environmental health practitioners of Provincial Health Departments. Implementation of health and hygiene education is done as part of the provision sanitation projects. Within the water sector, the responsibility to the implementation of health and hygiene education currently rests with the Department of Water and Sanitation which is also responsible for implementation of water and sanitation projects. Although the sanitation function which had the mandate to run the sanitation programme (including the health and hygiene programme) was moved to the Department of Human Settlements in 2009. Various programmes delivered through the National Sanitaion Programme Unit incorporated health and hygiene education and end-user training within the planning and delivery of sanitation projects. These programmes included: the schools and clinics sanitation programme; and the Rural Household Infrastructure Programme (RHIP) among others. Again, according to the National Health and Hygiene Education Strategy, the Department of Education must ensure that school curricula adequately address health and hygiene education.

In 2007, the National Sanitation Programme Unit of the then Department of Water and Forestry developed a communication strategy for sanitation advocacy with the objective to: disseminate information relating to sanitation legislation and policy to various stakeholders and communities; and also create awareness and understanding among communities on sanitation as well as health and hygiene. The National Health and Hygiene Education Strategy recognizes the key role municipalities need play in ensuring implementation of health and hygiene education both through municipal health services as part of local health care programmes or implemented within the delivery scope of water and sanitation projects at local level.

The 2001 Whitepaper on Basic Household Sanitation identifies lack of health and hygiene awareness as part of the unhygienic practices contributing to the sanitation problem in South Africa. The Whitepaper further acknowledges that good sanitation includes appropriate health and hygiene awareness and behaviour. It also emphasizes that improved sanitation coupled with health and hygiene promotion significantly impacts on people's lives. The health problems associated with poor sanitation that the Whitepaper identifies include diarrhoea, cholera, worms, eye infections and skin diseases among others. Furthermore, promotion of health and hygiene awareness and practices is one of the strategic interventions identified to address the sanitation problem. Health and hygiene education is aimed at changing behaviour, knowledge, attitudes and practices of community members through a health and hygiene programme and awareness campaigns. Whilst the programme is targeted at the community, the National Health and Hygiene Education Strategy identifies the priority target group of health and hygiene education as children, women and people affected by HIV and Aids and other sicknesses.

The South African government has developed a policy instrument called the National Environmental Health Policy to address environmental health-related problems in the country through preventative measures. The key objective of this policy is to prevent and reduce the spread of environmental health related diseases and conditions (DOH, 2013). Some of the key principles that guide achievement of the set National Environmental Health Policy objectives recognise the necessity for environmental health interventions to respond to the different needs of women, men, children and the elderly. These policy principles also encourage: prevention of poor environmental behaviour and practices; community participation; risk analysis and communication through standards and regulations, dissemination of accurate and current information on environmental health risks including prevention of these risks; and compliance through awareness and education.

The National Environmental Health Policy (DOH, 2013) defines environmental health as a “practice that seeks to protect human health by combating physical, chemical, biological and social threats in the environment”. As per this policy, environmental health practice encompasses assessment, correction, control and prevention of environmental factors that can adversely affect human health. Furthermore, it includes necessary measures to dealing with environmental degradation, climate change as well as the hazards relating to chemical exposure, air and water contamination.

The following strategies that are relevant to health and hygiene education and promotion, are set out in the National Environmental Health Policy (DOH, 2013) for achievement of environmental health policy objectives:

- Implementation and structure

This entails appropriate staffing and development of environmental health officials to ensure successful implementation of the National Environmental Health Policy with focus on planning, delivery as well as monitoring and evaluation of environmental health services. Strengthening capacity and development of environmental health personnel ensures that there is adequate number of quality “environmental health personnel with clear job description based on the scope of environmental health”.

Training and improving learning

The policy calls for the Department of Health to forge links with tertiary institutions as well as other training institutions for training of environmental health practitioners (EHPs). Over and above training, other key requirements to the achievement of the National Environmental Health Policy objectives that the policy highlights are: standardisation of environmental health training by relevant institutions for optimum utilisation of EHPs; a consultative review of the environmental health training curricula; a need for training and skills development to comply with the National Qualifications Framework and the Health Professions Council of South Africa; and collaboration between training institutions and industry on compulsory work integrated learning.

- Formulating an institutional framework

According to the National Environmental Health Policy, environmental health responsibility is shared by various departments such as the Departments of: Water Affairs (which is now called Department of Water and Sanitation); Environmental Affairs; Human Settlements; Agriculture, Forestry and Fisheries; Cooperative Governance and Traditional Affairs; National Treasury; Labour; Mineral Resources; and Transport. The National Environmental Health Policy also acknowledges the weak cooperation and collaboration amongst these departments on policy, programmes and plans. It then highlights the need for strengthening of cooperation and formulation of cooperative governance structures for promotion of synergy, alignment of plans, programmes and policies.

- Resource allocation for environmental health services

Emphasis is made on allocation of adequate financial, human and material resources for effective provision of environmental health services. The policy calls for municipalities to make adequate plans and also allocate appropriate resources for provision of environmental health services as well as the implementation of policy.

- Planning for proper implementation

The National Environmental Health Policy calls for proper planning at district and metropolitan level. It requires district and metropolitan municipalities to develop Municipal Health Plans and submit them (as part of their Integrated Development Plans and Subsequent Service Delivery and Budget Implementation Plans) to the Health District for collation of information into the District Health Plans. Emphasis is also put on the annual environmental health status reports which both district and metropolitan municipalities should develop and submit to the Provincial Department of Health, which then submits to National Department of Health. The policy calls for inter-sectoral engagement and participation in the planning process for the compilation of the annual environmental health status reports.

- Planning for human settlements

The National Environmental Health Policy highlights the importance of addressing health issues related to residential planning as well as the other key factors such as overcrowding and sanitation. It then calls for establishment of sewer works and a need to put in place proper environmental management plans for mitigation of the impacts of such factors as overcrowding and sanitation among others.

- Protecting children

The policy also emphasizes protection of children from environmental risks through promotion of a healthy environment at provincial and municipal government level.

- HIV/AIDS, TB, malaria and environmental health

The National Environmental Health Policy outlines the link between HIV/AIDS and environmental health related diseases such as diarrhoea and cholera, whereby immune compromised people are vulnerable to these diseases. The policy also stresses the importance of focusing education and awareness programmes on protecting vulnerable groups such as children, the elderly and people living with HIV/AIDS from environmental health related diseases in the provision of environmental health services.

National Health and Hygiene Education Strategy

In 2005, the then Department of Water Affairs and Forestry collaborated with the Department of Health through the National Sanitation Task Team for development of a National Health and Hygiene Education Strategy that would guide implementation of health and hygiene education within the delivery of water services by sector role players. The strategy provides guidelines to the effective delivery of health and hygiene education with the objective to change community hygiene behaviour and practices. This strategy attributes the risk of contracting waterborne diseases to unsafe hygiene practices as well as poor or lack of access to safe water and sanitation (NSTT, 2006).

To gain insight into what health and hygiene education entails, it is crucial for a distinction to be made between education and awareness in relation to the delivery of water and sanitation services as education could be confused with awareness. It is important to note that the National Health and Hygiene Education Strategy of the National Sanitation Task Team makes a clear distinction between health & hygiene education and health & hygiene promotion/awareness. The key elements of health and hygiene education are knowledge enhancement on health habits and practices aiming at long-term impacts on both attitude and behaviour within the context of water and sanitation services. With health and hygiene promotion / awareness on the other hand, the intended impact is short-term and it focuses on creation of health & hygiene awareness through once-off activities (NSTT, 2006).

5.2.1 Institutional framework for environmental health policy implementation

National Department of Health

The National Health and Hygiene Education Strategy (NSTT, 2006) sets out the institutional arrangements with clarity on the roles that all key national government departments are expected to play in as far as health and hygiene education is concerned. As custodians of health and hygiene education, the National Department of Health plays the leading coordination role of planning interventions that influence community health and hygiene behaviour and also “creating a demand for sanitation services through health and hygiene awareness and education programmes”. Importantly, the Department of Health is also responsible for norms and standards with respect to health issues within water and sanitation services.

The National Environmental Health Policy places the National Department of Health at the centre of development of policy as well as the facilitation and monitoring of policy implementation. It also facilitates implementation of environmental health programmes and provision of environmental health services (in collaboration with other stakeholders) by provinces and municipalities in line with national priorities. The National Department of Health provides technical support to provinces in management and capacity development.

- Provincial Government
- Local Government
- Other stakeholders
- Civil society
- Business and industry
- Organised labour
- Community-based organisations (CBOs)
- Non-governmental organisations (NGOs)
- Professional organisations and associations

5.3 Health and hygiene interventions

The following interventions are reviewed:

- Department of Water and Sanitation interventions:
  - WASH – launched by DWAF Minister in October 2003
  - Water Week
  - Sanitation Week
  - South African Youth Water Price Competition
- Department of Health (national and provincial) interventions
  - Integrated School Health Programme (School Health Nurse Resource Manual – 2012) http://www.education.gov.za/LinkClick.aspx?fileticket=kN%2FI2VVGCG4%3D&tabid=667
- Department of Human Settlements interventions
- Department of Education interventions
- Western Cape Education Department School-based deworming programme 2009 http://wced.pgwc.gov.za/circulars/minutes09/IDCminutes/edse9_09.html
- Baswa Le Meetse
- Women in Water Awards
- Soul City Water and Sanitation Manual: Breaking the Rules, New Approaches to Water and Sanitation and Health in SA. http://www.soulcity.org.za/training/water-and-sanitation-materials
- School sanitation and hygiene education in Maharashtra, India (Unicef, 2007)
- The Maharashtra School Sanitation and Hygiene Education partnership between Unicef, government and communities

5.4 Health and hygiene education materials

The following materials have been identified:

- Hygiene Education Promotion Material – Department of Human Settlements
- Shape the future life of children: Healthy Environments for Children in South Africa – WHO and SA Department of Health http://www.mrc.ac.za/environmenthealth/intro.pdf
- Draft Health and Hygiene Education User Guide – Department of Water Affairs and Forestry
- DWAF Sanitation for a Healthy Nation Poster
- 2020 Vision for Water Programme (A resource pack for active learning in water and environmental conservation in South African schools and communities, for educators, community development facilitators and environmental health officers)

5.5 Studies and reviews of interventions

The following studies will be reviewed:

- A review of sanitation and health promotion as part of sanitation delivery programmes to informal settlements (city of cape town), Community Water Supply & Sanitation Unit, Cape Peninsula University of Technology
  http://www.ewisa.co.za/literature/files/277%20van%20Wyk.pdf
- Phaswana Study on Safe Hygiene Practices in Eastern Cape Rural Communities
- A Study on Water related Diseases – DWAF 2010

5.6 Best practice for implementation of health and hygiene education and awareness

This section looks at sanitation best practice for both institutional and household sanitation in as far as sanitation provision and promotion of health and hygiene education is concerned. A lesson learning approach to raising health and hygiene awareness is looked at, with best practice by different countries explored to establish the best available approach.

Focus of the literature review will also be on methodologies that can be used to deliver health and hygiene education and awareness messages as part of sanitation provision.

Health and hygiene education should happen during planning, implementation and monitoring stages of sanitation delivery through baseline survey, user education and the actual monitoring.

Documents for review:

- Unicef Hygiene Education Manual: Technical Guidelines Series
- India's Integrated Communication Strategy for Creating Awareness on Sanitation and Hygiene Behaviours

- Rural Sanitation and Hygiene Practices: Frequently asked questions. WSP World Bank. Questions based on study done in India and is based on research and fieldwork by the Bill and Melinda Gates Foundation
- Sanitation and Hygiene Promotion Programming Guide – Water Supply and Sanitation Collaborative Council (WSSCC) and WHO
- Advocacy Sourcebook: A guide to advocacy for WSSCC coordinators working on the WASH campaign. Water Aid/WSSCC 2003
- PHAST Step-by-Step Guide: A Participatory approach for the control of diarrhoeal transmission
- An Essential Package of School-based Interventions in Southern Africa: Regional Strategy for Country Action. Unicef 2005

The following methodologies are proposed for delivery of health and hygiene education.

- PHAST

- WASH programmes including events and road-shows targeting decision makers, community members, school educators and learners
  - Water Week
  - Sanitation Week
- Electronic and print media
  - Radio broadcasts, advertisements and advertorials
  - TV adverts and live broadcasts
  - Newspaper inserts
  - Sector specific publication
  - Featured adverts on other non-sector publications
- School curriculum activities
  - 2020 Vision for Water
  - Baswa Le Meetse
  - Youth for Water Prize
- School extra-mural activities
  - Educational dramas
  - Story telling
- Women in Water Awards
- Workshops targeting focus group such as community health clubs, women's groups, men's groups, local traditional leadership, church groups
- Household visits
- Awareness campaigns targeting public institutions such as clinics and libraries
- Exhibitions

The following materials could be used for implementation:

- Health and hygiene education manuals targeting health practitioners
- Posters
- Bill board messages
- Pamphlets

- Banners
- Comic books
- SABC education programmes
- WASH songs on CD
- Caps and t-shirts
- Flyers
- Drama scripts

The review of literature on health and hygiene education will also focus on training as part of building capacity to raise community awareness to change attitudes and behaviour. Training of environmental health practitioners through accredited training programmes will help better deliver health and hygiene awareness messages to the targeted groups.

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