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TRANSFORMATION TOWARDS SUSTAINABLE
AND RESILIENT WASH SERVICES

**Health and safety: handling faecal sludge in the
Pollution Research Group's laboratory facilities**

T. Zikalala & M. Reddy (South Africa)

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The Pollution Research Group (PRG) is a WASH research laboratory that is well experienced in handling hazardous biological agents. Handling FS requires intricate knowledge of health and safety protocols and good laboratory practices. Safety is the first priority when handling hazardous biological materials as these materials could potentially carry infectious pathogens that can cause harm to handlers. Precautions should be taken by all stakeholders involved in sampling, transporting and analysing the biohazardous material. There is still a need to bring awareness to new FS laboratories as employers have the responsibility of educating all employees and researchers exposed to hazardous biological materials.

Introduction

The Pollution Research Group (PRG) is a professional research centre based in the University of KwaZulu-Natal's Chemical Engineering Department in Durban, South Africa and conducts research on water, sanitation and hygiene (WASH) research projects, primarily focused on FSM, onsite sanitation systems and evaluation of innovative non-sewered sanitation technologies. PRG has gained significant experience in handling hazardous biological materials (HBA's), such as fresh human faeces, urine, faecal sludge (FS), wastewater and industrial effluent. These samples contain viruses, bacteria and parasites, some of which do not pose risk to the human health but many of can be potentially hazardous to human health and the environment. This paper aims to highlight the health and safety protocols when handling hazardous biological materials in faecal sludge research laboratories.

HBA's are divided into four groups as per the Regulations for Hazardous Biological Agents (HBAs), Group 1 are HBA's that are unlikely to cause human disease. Group 2 are HBA's that may cause human disease which is unlikely to spread to the community and for which effective treatment is available e.g. hepatitis B virus. Group 3 HBA's cause severe human disease, which is at risk of spreading to the community and for which effective treatment is available e.g. mycobacterium tuberculosis. Group 4 are HBAs that cause severe human disease, which is at high risk of spreading to the community but for which no effective treatment is available. E.g. ebola virus (DoL, 2001). Faeces potentially harbour *Eschericia coli*, *Salmonella typhi*, *Salmonella paratyphi* and *Schistosoma haematobium*, *Ascaris Lumbricoides*, *Trichuris trichiura* and *Hookworms*. These pathogens can cause gastrointestinal illnesses, influenza like symptoms, typhoid fever, paratyphoid fever and schistosomiasis (Strenstrom, 2004) which potentially puts PRG in a HBA's Group 2 but further investigations are required and records of biological outbreaks in the area need to be documented and assessed. The main source of infection are the faeces, urine and blood in the sludge samples (Stenström, 2004). Pathogens can cause infections through different routes of entry, from source to host namely, when directly ingested by putting contaminated gloved hands in mouth or by splashes into eye or mouth; inhalation of infectious droplets from air; or can enter the human body through open skin cuts and wounds. FS laboratories handle HBA's that potentially carry all of these pathogens therefore appropriate health and safety practices are a necessity to protect workers from contracting diseases (CRC, 1990).

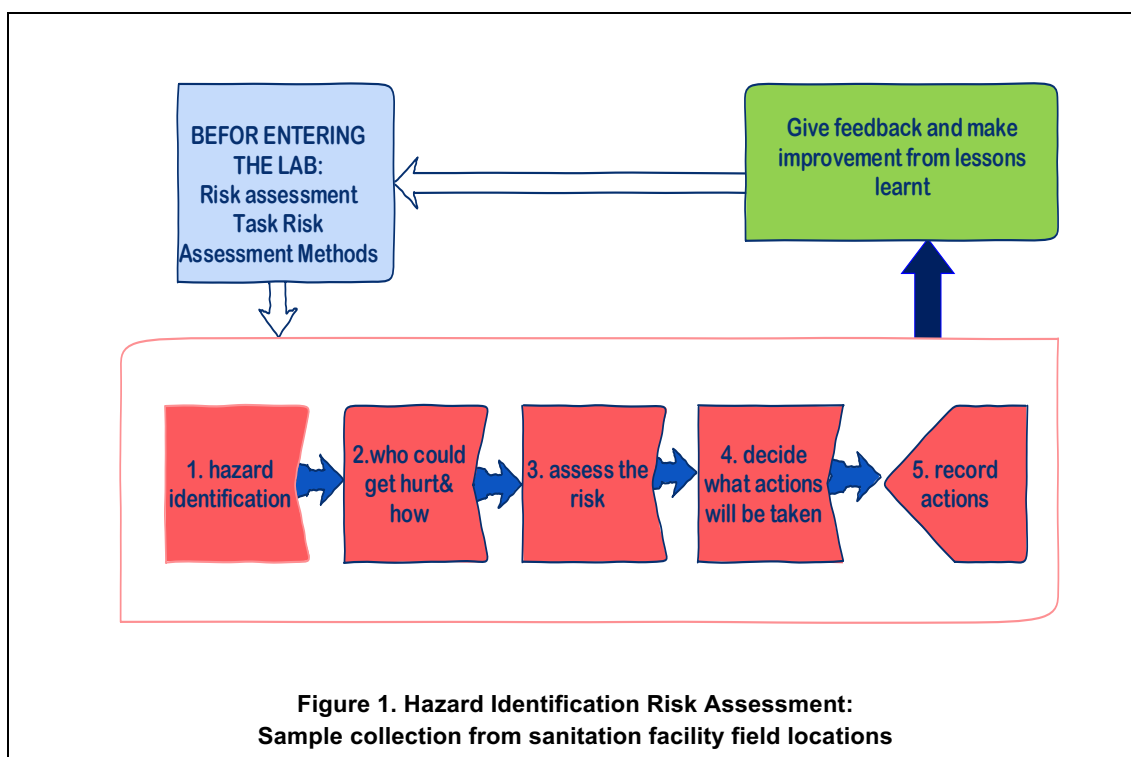
It is the responsibility of every person to maintain a safe and healthy environment when carrying out tasks in the laboratory. Health and safety in the laboratory to control and minimise the risk of incidents or

infections for laboratory personnel (APHA, 2012). In order to protect laboratory personnel from contracting diseases, vaccinations are administered as another control measure. However, personal protective equipment (PPE) plays an important role as the first barrier against pathogens and harsh chemicals. Basic PPE consists of a laboratory coat, gloves, safety glasses, respiratory masks and safety shoes (APHA, 2012). The choice of appropriate PPE and precautionary measures depends on the tasks that are being undertaken and the hazards which can be established through a risk assessment is necessary. Risk assessments should be carried out before undertaking any task in the laboratory.

Methodologies

Risk assessments

Section 8 of the South African Occupational Health and Safety Act, 85 of 1993 states that “every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of employees” (DoL, 2001). The PRG has implemented a management system addressing this regulation which assists in minimizing occupational risk and injury by controlling the researcher's exposure to HBA's. This is carried out in the form of a risk assessment to document the likelihood of harmful events and the necessary corrective measures that are needed to minimise risk of harm. It is important to remember that the risk assessment is a living document and should display any changes in the work carried out and to be reviewed every six months to assure that the controls being used are still effective. PRG carries out hazard identification risk assessments (HIRA for all the stages of the FS testing process i.e. sampling, transporting, testing and disposing of HBA's based on 4 main listed below.



PRG has established a risk assessment format that has been developed over the years for the sampling procedure. Durban is a hilly terrain, not suitable for small vehicle especially those that are not equipped to carry faecal sludge samples. PRG uses the eThekwin municipality vehicle to transport samples as well as a community liaison, someone familiar to the place and can calm the community in case it should pose as a threat. A risk assessment should take diseases outbreaks in consideration, Durban suffered a cholera outbreak in 2010, no sampling takes place in case of outbreaks, however appropriate PPE should be worn at all times. Appropriate sampling tools are available for sampling different type of systems such as the ventilated improved pit or urine diversion toilets as shown in Photograph 2.

Table 1. Hazard Identification Risk Assessment: Sample collection from sanitation facility field locations			
List Major Task Steps	What are the Hazards	What are the risks	Control Measures (PPE/Safe Work System/Engineering control/Substitution/Elimination)
Travel to field location	Roads	- Road accident	Roadworthy, appropriately insured vehicles with seatbelts for all occupants to be used. Driver to have appropriate license. Inform person at office of intended destination and estimated return time; provide full contact details of all team members involved in the trip; ensure there are enough fully recharged mobile phones. Emergency numbers and first aid kit
Collect representative samples from facility into small containers	Biological samples	- Pathogen risk from contact with excreta - spillage of sample	Lids to be well fitted to sample containers before being removed from the facility. PPE (Photograph 1) to be worn, including safety boots, overalls, elbow length and sharp-resistant gloves, dust masks and goggles, Vaccinations against Hepatitis A and B, tetanus and typhoid; prophylactic use of anti-worm medicines. In case of spillages/ splashes: <u>environment</u> : spill to be cleaned with diluted jik (i.e bleach) and paper towels; see SOP/Biological spills; <u>person</u> : rinse affected area with water, dry with paper towel, spray with 98% Ethanol; see SOP/Biological spills
Sampling in community	Members of the public	- Risk of conflict with members of public	Liaise with relevant officials at municipality Arrange introductions to caretaker and/or householder in charge of facility before starting sampling, ensure they are kept informed about activities taking place Use local facilitators where advised to do so by municipality. Site induction is essential
Transport of sample from field location to lab	Road Biological samples	- Road accident - Sample spill	Roadworthy, appropriately insured vehicles with seatbelts for all occupants to be used. Driver to have appropriate license. Lids to be fitted well to sample containers and placed in a bigger container before being removed from the facility Secured well at the back of the van In case of spillages/ splashes: <u>environment</u> : spill to be cleaned with water and paper towels; see SOP/Biological spills; <u>person</u> : rinse affected area with water, dry with paper towel, spray with 98% Ethanol; see SOP/Biological spills
Storage of sample at lab	Biological sample	- Samples transported to and stored in an unsafe manner resulting in contamination risk to environment and/or personnel	Samples to be labeled appropriately whilst in the field and sample number recorded on paper record Full sample containers to be taken from vehicle, through basement access door to lab and placed immediately in coldroom as shown in Photograph 3. Paper record of samples to be transferred to database

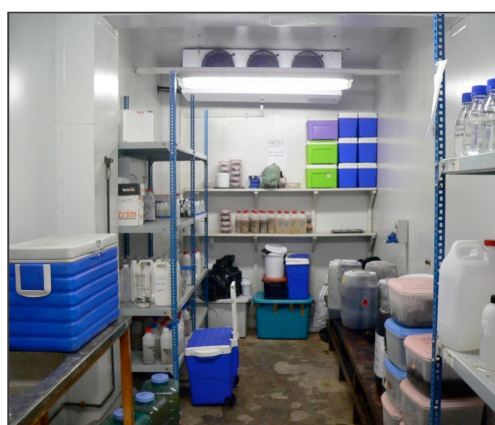
<p>Cleaning/ washing of PPE</p>	<p>Biological</p>	<p>- PPE stored /exposed and disposed in an unsafe manner resulting in contamination risk to environment and/or personnel</p>	<p>Sharp-resistant gloves to be washed/ sprayed with ethanol, then placed in a plastic bag and washed well in the lab using anti-bacterial detergent. Overalls and safety boots to be placed in plastic bags before leaving the field, then washed/ placed for washing within the same day in the lab. Gloves and dust masks to be placed into a separate plastic bag and disposed in allocated areas for contaminated wastes within the lab. Goggles to be washed and disinfected in the lab.</p>
<p>Disposal of samples</p>	<p>Biological</p>	<p>- Splashes could result in infections Sample spillage</p>	<p>Essential to wear the correct PPE. Small amounts of samples can be discarded down the sluice (Photograph 4)</p>



Photograph 1. Actual sampling



Photograph 2. Sampling containers



Photograph 3. Temperature controlled room for FS storage



Photograph 4. Sluice for sample disposal

As per photograph 2, 3, 4 faecal sludge samples are collected using the correct PPE and sampling containers. Samples are stored at a temperature controlled cold room and disposed down the sluice as per government regulations.

Conclusion and observations

Based on the experience of PRG, every task is done concurrently with health and safety as it is regulated by law. PRG has demonstrated a health and safety management system in which can be adopted by other researchers in the field. After collaborative efforts with other developing FS laboratories, shortcomings and gaps in other FS research laboratories has been observed. It is critical that PRG raises more awareness to ensure a safe working environment for everyone by ultimately providing low cost health and safety solutions for developing laboratories if possible.

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Contact details

Thabiso is a Senior Laboratory Technician at the PRG. He holds a BSc in Microbial Biotechnology and a BSc Honours in Biochemistry. Mrs. Merlien Reddy is the Laboratory Manager and is responsible for overseeing and facilitating all research activities and analysis in the PRG laboratory. This includes organisation and supply of lab equipment, operational supervision of researchers and students and issues related to health and safety.

Thabiso Zikalala
University of KwaZulu-Natal
Pollution Research Group
Chemical Engineering
King George V Avenue
Durban
4001
Tel: 031 260 1360
Email: zikalala@ukzn.ac.za

Merlien Reddy
University of KwaZulu-Natal
Pollution Research Group
Chemical Engineering
King George V Avenue
Durban
4001
Tel: 031 260 1360
Email: [reddym5@ukzn.ac.za](mailto:redm5@ukzn.ac.za)