

# Environment and Health International



*Magazine of the International Federation of Environmental Health*



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**Ebola affected in excess of 25,000 people in Africa in particular Guinea, Sierra Leone, Liberia and Nigeria with over 11,000 deaths occurring. There was one death in the United States and one in Spain. Source ( WHO, 2014 )**

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### **Cover page picture**

“ Mother & Child “ Ebola Crisis 2014.

Image of Ebola crisis courtesy of Pinterest.com

## **About IFEH**

### **INTERNATIONAL FEDERATION OF ENVIRONMENTAL HEALTH**

The Federation works to disseminate knowledge concerning environmental health and promote co-operation between countries where environmental health issues are trans-boundary. It promotes the interchange of people working in this sector and the exchange of Member's publications of a scientific and technical nature.

Amongst other things, the Federation seeks to provide means of exchanging information and experience on environmental health, to hold Congresses and meetings to discuss subjects relevant to environmental health science and administration, to represent the interests of environmental health to state agencies, national governments and international organisations and to promote field studies of environmental health control.

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<sup>1</sup>Rod House, CIEH, Peter Archer CIEH, Peter Davey EHA Australia, Kathryn Young, EHA I Republic of Ireland, Steve Cooper CIEH Northern Ireland, Henning Hansen EnviNa Denmark. Officers of the Board of the International Federation of Environmental Health attending NEHA/IFEH Global Environmental Health conference in Las Vegas 7-11<sup>th</sup> July 2014

## IFEH President Perspectives

*By Henning I. Hansen, President IFEH*



### Dear friends and colleagues

In this article I will look a little back, look at what has happened since the World Congress and finally look a little forward.

Let me start by thanking our Hon. Editor Kathryn Young who has produced this edition of the Environment & Health International.

In July 2014 at the Las Vegas World Congress I succeeded Dr Peter Davey as IFEH President. I would like to send my sincere thanks to Peter Davey who in his presidency worked tirelessly (and still does) to move the

Federation forward and he has left Office with the Federation in as good a shape as ever. The 13th IFEH World Congress on Environmental Health was held in conjunction with the 78th Annual Educational Conference & Exhibition in the fabulous Las Vegas. The National Environmental Health Association of America (NEHA) hosted and organised this huge event did a fantastic job. The Congress was very successful and enjoyed a large attendance of delegates from the USA and member countries of the Federation. The 13th IFEH World Congress, in partnership with the NEHA 2014 AEC, brought the latest innovations and unique responses to environmental health and protection problems. More than 20 different environmental health topics were brought forward through educational lectures, hands-on demonstrations, tabletop exercises, panel discussions, poster presentations, roundtable discussions, and other types of interactive and innovative presentation formats.

I would like to extend my deepest thanks to NEHA for hosting this very successful World Congress.

Particularly I would like to thank Mel Knight Chair of the IFEH Americas Group, Nelson Fabian, past CEO, Past President Alicia Enriquez Collins and incoming NEHA President Carolyn Harvey. Also thanks to IFEH Secretary Rod House and IFEH Treasurer Steve Cooper.

Finally, I would like to extend my deepest gratitude to those companies who sponsored some of the IFEH activities: Hedgerow Software Ltd., NSF International, Underwriters Laboratories and Decade Software.

The Hedgerow Bursary enabled the IFEH to welcome participators from developing countries to take part in our Council Meeting and AGM. This will be the case also in regard to the Coimbra meeting. This valuable support allowed for debate and consideration which better reflected the wide membership of the Federation. These

sponsorships are very important to the work of IFEH and us to facilitate and finance our many initiatives. My sincere thanks go to past IFEH President Robert Bradbury for his great efforts in ensuring continuing sponsorships to the work of the IFEH. Lately he has secured a new sponsorship to The Roy Emerson Award 2015 and the 2017 Award from Highfield Publications and RH Environmental.

I am looking forward very much to our first IFEH World Academic Conference on Environmental Health which takes place in Coimbra, Portugal 22 – 26 September 2015. The host, Coimbra University (the oldest in Europe), is working very hard on making this a great success. I would like to give my personal thanks, especially to Prof. Susana Paxio and her organising committee for organising this great event. I look forward to meeting many of you in Coimbra. Please look up the Conference website: [www.gehff2015.pt](http://www.gehff2015.pt) and don't forget to see their great Conference streaming on YouTube: [www.youtube.com/watch?feature=player\\_embedded&v=Q03cfrEgBE4](http://www.youtube.com/watch?feature=player_embedded&v=Q03cfrEgBE4)

Since the World Congress and since our last IFEH Council Meeting several important activities have taken place and new initiatives are under its way.

## **WHO & IFEH**

**26th September 2014** - An IFEH delegation, represented by Peter Archer and Janet Russell from CIEH together with Peter Wade, ENVINA met with the WHO at the UN City in Copenhagen, Denmark in order investigate possibilities of developing a WHO/IFEH Partnership. The reference being the IFEH Declaration of Health Equity - Closing the Gap in a Generation. IFEH Policy No.10, August 2012. (This initiative is further described in the article by IFEH President Elect Peter Archer, following this article)

**27–29th August 2014** - Henning Hansen, President of the IFEH, was invited by the WHO, to participate in the WHO International Congress on Health and Climate at WHO Headquarters in Geneva. This conference on Health and Climate was the first of its kind organised by the WHO as emphasised by Dr Margaret Chan, Director General, WHO. The Congress was attended by 400 participants, including Health and Environment Ministers from WHO Member States, senior civil servants, technical experts, UN Agencies, NGOs, Chief Executives from Health Authorities and relevant private sector entities.

At the final plenary session, discussing the outcome and conclusions of the conference, I as IFEH President took the floor where I stressed the need for including Environmental Health Professionals in the coming processes as EHP's are at the very core when it comes to the daily work of facing the challenges that climate change imposes on human health. EHP's are representing the regulatory body in the interface with affected people. Also I stressed the need for capacity building relating to Environmental Health in response to the challenges arising from Climate Change. Finally I enlightened the assembly about the IFEH EH Disaster Management and Risk Reduction Initiative which is very relevant in acute responses to the impact of climate change.

The meeting welcomed my intervention and it was noted by the WHO chairman of the meeting in her final summarising remarks. Just after the meeting I was approached by several representatives including, United Nations Environment Programme (UNEP), regional office of the WHO as well as several state officials etc. We are currently building on these opportunities of co-operation with the IFEH.

The meeting produced a summary that recognised the need to strengthen health resilience to climate change and the opportunity to make gains in public health through well planned mitigation measures. The summary notes weaknesses in the international health responses to climate change, including: weak engagement of the health sector in national and international climate policy processes, the lack of technical capacity to create and implement health adaptation plans, and inadequate financing. It further identifies needs, including for: supporting the health sector in UNFCCC engagement and in the development of NAPs; creating common metrics; providing guidance to the health sector on climate risks and emission reduction benefits; and guidance on resource mobilization.

WHO expressed its intention to host a platform on climate change and health, as well as to finalise a summary as an outcome document and use it to input to UNFCCC COP21, the post-2015 development agenda discussions, and the 2nd Hyogo Framework for Action on Disaster Risk Reduction in 2015



*Delegates at the first-ever WHO Health and Climate Conference (IFEH President: center 4<sup>th</sup> row)*



*Delegates settle into the plenary to discuss the final summary and conclusions*

More information about the WHO Conference on Health and Climate:

[www.who.int/globalchange/mediacentre/events/climate-health-conference/en/](http://www.who.int/globalchange/mediacentre/events/climate-health-conference/en/)

Official reporting service on the Conference produced by IISD: [www.iisd.ca/who/hcc/](http://www.iisd.ca/who/hcc/)  
and the summary [www.iisd.ca/download/pdf/sd/crsvol224num1e.pdf](http://www.iisd.ca/download/pdf/sd/crsvol224num1e.pdf)

The final WHO Conference report:

[www.who.int/globalchange/mediacentre/events/climate-health-conference/whoconferenceonhealthandclimatechangefinalreport.pdf?ua=1](http://www.who.int/globalchange/mediacentre/events/climate-health-conference/whoconferenceonhealthandclimatechangefinalreport.pdf?ua=1)

## **IFEH & UNEP**

As one of the outcomes of IFEH participation in the WHO Health and Climate Conference, I as IFEH President, have had several tele-conference meetings with representatives from the United Nations Environmental Programme UNEP. The UNEP is in a phase where they are preparing a new strategy to more systematically address the linkages between environment and health through the UNEP work programme. Through our talks IFEH and UNEP have identified several topics where co-operation would be beneficial and which we are following up on.

These are the mutual conclusions so far:

1. Important areas where the UNEP could collaborate with IFEH to our mutual advantage and that the scientific and technical expertise that IFEH represent can be a

great asset for UNEP as UNEP defines their strategy to more systematically address the linkages between environment and health through the UNEP work programme.

**2.** Partnership with UNEP can be considered to our mutual advantage, notably the IFEH Environmental Health Disaster Management Principles and Practices, the World Environmental Health Day, Sustainability Indicator Initiative ( SII ), and the annual scientific Congress.

**3.** Possible IFEH participation in on-going UNEP/WHO work in the Africa Region under the frame of the commitments of the Libreville declaration of ministers of Health and the Environment in the region.

Further information:

[http://www.who.int/profiles\\_information/index.php/AFRO:Progress\\_on\\_the\\_Libreville\\_Declaration](http://www.who.int/profiles_information/index.php/AFRO:Progress_on_the_Libreville_Declaration).

**Regarding item 1.** it is my intention to set up an IFEH Committee with representation from all IFEH Regions which has been welcomed by UNEP.

**Regarding item 2.** Dr. Peter Davey and his project team on the IFEH EH Disaster Risk Reduction and Management Initiative is following up on the potential partnership with UNEP.

UNEP would welcome an invitation to give a presentation at the IFEH World Academic Conference in Coimbra in September 2015.

**Regarding item 3.** Jerry Chaka, Chair of the IFEH Africa Regional Group has welcomed the possible partnership in relation to the UNEP/WHO regarding the Libreville declaration of ministers of Health and the Environment in the region. UNEP would welcome an invitation from the IFEH African Group to give a presentation at the All African Congress on Environmental Health, Nigeria in December 2015.

## **NEW IFEH STANDING SPECIAL INTEREST GROUPS**

The IFEH Board of Directors has approved a proposal from the IFEH President to form several standing IFEH Special Interest Groups (SIG) in relation to many of the EH topics that the IFEH member organisations and their individual members are engaged with. The purpose of this initiative is to get full use of the very great pool of experience that resides in the Federation through its 50,000 plus individual professionals in the field of Environmental Health. In this way each of the 50,000 plus professionals inside the IFEH membership can easily reach out for the experience from their colleagues throughout the World when needed and also each of the groups can help the Federation in producing positioning papers etc. The SIGs could also play an important role when the Federation is engaging with other official organisations as the WHO,

UNEP, OECD etc. as well as other international organisations and potentially, on behalf of the IFEH, take part in specific international projects etc.

Each of the Standing Special Interest Groups is intended to have a named chairperson. The groups for the moment are intended to be on a global level but, if needed, regional groups could be created as well. Groups can be established or can be put to rest depending on the need. New Groups are to be acknowledged by the IFEH Board of Directors.

The IFEH Board of Directors has decided initially to form these standing IFEH Special Interest Groups (SIG) – (the order of numbering of the SIG is of no significance)

- 1. Disaster Risk Management**
- 2. Communicable Disease**
- 3. Food Safety & Security**
- 4. Waste Management**
- 5. Drinking Water**
- 6. Wastewater Management**
- 7. Air Pollution**
- 8. Noise pollution**
- 9. Pollution from Industry**
- 10. Nature & Wild Life Protection**
- 11. Public Health & Health Equity**
- 12. Housing and Shelter**
- 13. Environmental Health & Climate Change**

There will be a consultation for comments from IFEH members – and call for nominations of chairpersons.

The chairperson of each SIG has to be member of one of the IFEH Member organisations or IFEH Associate/Academic members but doesn't need to be an IFEH Council Member. Initially the chairpersons will be approved by the BOD based on the inputs from member organisations but when running, the SIG can chose the chairperson (annually) by themselves. As President I wish to encourage that the chairmen is elected from the great pool of members not being delegates to the IFEH Council but not excluding IFEH Council Members, especially in the start up phase.

For each of the SIGs the Federation will establish a LinkedIn Group with protection where membership has to be granted by the chairman of the Group or before such is established by authorisation by me as President or another person that the BOD give authorisation to. I hope that somebody who is not a member of one the IFEH member organisations or associated/academics would like to participate and I welcome this but if they are not a member of an IFEH Member Organisation etc. they will need to be an individual member of the Federation before being authorised to join an SIG. When this is confirmed they are welcome to participate in the SIG.

## **IFEH – WFPHA**

I proposed and The Federation has approved, through the IFEH Board of Directors, that we form a partnership with the World Federation of Public Health Associations (WFPHA) [www.wfpha.org](http://www.wfpha.org)

WFPHA and IFEH are now mutual associate members of each of our organisations. The WFPHA is a similar organisation to the Federation but with greater public health interest. They have national member organisations in approximately 100 countries. Their main focus is on the health aspects but also on the Environment and its impact on human health. I met with their CEO Betinna Borisch in Geneva during the WHO Conference. And here we set out the partnership which includes:

1. An associate membership of both organisation vice versa could be envisaged;
2. A collaboration of the WFPHA working group on environmental health and the IFEH seems to be a great opportunity
3. Joint activities such as crossed posting on newsletters and websites of the two organisations would be another tool of advancing environmental health.

## **IFEH REGIONAL GROUPS – SOME HIGHLIGHTS**

It is my impression that there is relatively good activity in the IFEH Regional Groups. The Regional Groups are in my optics the very backbone of the IFEH.

**Africa Group:** Chair Jerry Chaka, South Africa; Secretary David Musoke, Uganda. The Africa Group is once again organising a great “All African Conference on Environmental Health” to take place in Nigeria in December 2015. This is the third of its kind and the Africa Group leads the way for all of our regional groups in this regards. Next to this, the Africa Group of course is also into the planning of the 2016 IFEH World Congress to take place in Malawi.

**Americas Group:** Chair Mel Knight, US; Secretary Dr Sylvanus Thompson, Canada, US, Jamaica. After having done a great work regarding the 2014 IFEH World Congress in Las Vegas, the Americas Group is working hard on engaging even more members to the group and to the IFEH with a focus on the South America. The Jamaican Association would like to host a future IFEH Council meeting and/or Academic Conference.

**Asia and Pacific Group:** Chair Dr Peter Davey. The Group is continuing its success with the IFEH EH Disaster Management and Risk Reduction Initiative. Many courses have been run in the Asia and Pacific Region and now also courses are being set up in Europe. I congratulate Peter Davey, Ben Ryan and Tim Hatch on this great endeavour.

**European Group:** Chair person Jan Homma, Netherlands; Secretary Steve Cooper, England, Wales, N. Ireland. The European Group (EFEH) lately attended a very successful group meeting kindly hosted by the relatively new member, Chamber of Sanitary Engineers of Slovenia. The EFEH is continuing to be very active. The Group is engaged in the planning of the up coming World Academic Conference to take place in Coimbra, Portugal next year.

**Middle East Group:** Chair Rasheed Ahmed / Ahmed S. Al Harkan. The Group is trying hard to engage more national associations in the region to become member of the Group and the IFEH. The Group is taking active part in all BOD meetings. Until the Group has established a larger group of members it has been welcomed to take part in the EFEH Group meetings.

### **IN CONCLUSION**

The IFEH is still growing in size and in terms of activities, collaboration and in terms of recognition.

It is my impression that the Federation is on the right path and I am confident that this development will continue.



**Henning I. Hansen**  
President IFEH

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## **Declaration of Health Equity - closing the gap in a generation IFEH Policy No. 10 – August 2012**

***By Peter Archer, IFEH President Elect***

It is the International Federation of Environmental Health's declared intention to work through our member organisations and partners to work to reduce health inequalities and to close the gap in a generation. In August 2012 the IFEH Council approved the new policy ([www.ifeh.org/docs/ifeh\\_policies/policy10.pdf](http://www.ifeh.org/docs/ifeh_policies/policy10.pdf)). The targets set within the policy are diverse and every environmental health professional has a personal responsibility to work to reduce the inequalities in health.

In 2008 a WHO Commission, led by Professor Sir Michael Marmot, reported that a girl born in some countries could expect to live more than 80 years but in others just 45 years. However, the difference is not just restricted to being born in different countries, in parts of the UK life expectancy is 82 years but in others, only a few miles away, it is just 54. It is not just a matter of poor water, inadequate sanitation, or good nutrition; there is a 'social gradient' in health. This is related to social scale & extent of control over one's life. Sir Michael Marmot's WHO report concludes '**social injustice is killing on a grand scale**' & calls on all governments '**to close the gap in a generation**'. The WHO Commission in 2008 argued that '**achieving health equity within a generation is achievable, it is the right thing to do, and now is the right time to do it**'. The WHO outlined the following three principal actions for all member states.

1. Improve the conditions of daily life – the circumstances in which people are born, grow, live, work, and age;
2. Tackle the inequitable distribution of power, money, and resources – the structural drivers of those conditions of daily life – globally, nationally, and locally;
3. Measure the problem, evaluate action, expand the knowledge base, develop a workforce that is trained in the social determinants of health, and raise public awareness about the social determinants of health;

At the IFEH World Congress in Vancouver in 2010 Dr Stephen Battersby, former President of CIEH, presented a paper detailing the recent work of WHO and outlined EHPs' potential contribution in tackling the wider social determinants of health. Since then Peter Wade of ENVINA, and Janet Russell and Peter Archer from CIEH have been working to ensure that IFEH Policy 10 is fully understood and that projects for reducing health inequality are evaluated and monitored. On 26<sup>th</sup> September 2014, World Environmental Health Day, Peter Wade, Janet Russell and Peter Archer met WHO colleagues at UN City in Copenhagen to see if we could develop a WHO/IFEH Partnership. In November 2014 Peter Archer met Prof. Michael Marmot, from the Institute of Health Equity in London to see how the involvement of IFEH Member Organisations could contribute to the overall programme on health equity.

At the World Congress in Las Vegas in July 2014 Janet Russell and Peter Archer presented a paper 'Closing the gap – 101 postcards' when we highlighted numerous projects being undertaken by EHPs on every continent. From clean water initiatives in Kenya to high tech air quality warning services in London, we were able to describe how EHP involvement makes the difference to everyday life! It is the intention to monitor and evaluate the projects over a period of years.

If you would like to see the Las Vegas presentation, please go the IFEH website

[www.ifeh.org](http://www.ifeh.org), [direct link](#)

We want to add many more projects to the '101 postcards', it has been suggested we should try for '1001 postcards'! If you would like to join us, please contact Peter Archer at [peter.archer@thcp.org](mailto:peter.archer@thcp.org) you will be most welcome.

**Peter Archer, CIEH.**

## Editorial



I am very pleased to contribute to the July 2015 issue of Environment and Health International magazine. A lot has happened since the last edition which was on the eve of the Las Vegas Global Environmental Health conference in 2014 where a very successful joint NEHA/ IFEH meeting occurred. Henning Hansen has now succeeded Peter Davey as President of the IFEH and in Presidents Perspectives we see his global vision of the organization for the future. We congratulate Henning on taking up this important position and leading the way for the IFEH in developing policies and practices that will no doubt lead to an improvement in Global Population Health. Peter Archer as our new President Elect

is also wished well.

We must extend our appreciation to former IFEH President Peter Davey and in particular to the success of his course on Disaster Management so vitally needed and which will be presented in Coimbra, Portugal in September 2015

This year we have the IFEH 1<sup>st</sup> World Academic Congress on Environmental Health hosted by the College of Health Technology of Coimbra in Portugal to look forward to from September 22-26 at Coimbra Health school details of which are contained in Henning Hansens article. This is the first time that the International Faculty Forum of Environmental Health has held its academic conference separate from the IFEH and we wish it every success in September and with future endeavours.

The WHO although criticized for its delay in reacting did declare the Ebola outbreak an International Public Health Emergency under the International Health Regulations. The Ebola crises devastated lives in Africa and Ireland along with other countries was involved in developing protocols at ports to protect and prevent transmission of disease. Bush meat was seen as a potential threat along with visitors from affected regions. Over 11,000 people died in the tragedy and secondary infection played such an important role in the transmission of disease. Scenes of utter devastation were transmitted around the globe and WHO have developed protocols, which feature in the IFEH recent newsletter which are a valuable resource. Being ever vigilant against the transmission of disease is something that EH professionals know all about but it is getting this message across in the most effective way that is hugely important for success as demonstrated in the first article of this edition which indicates that maternal education is one of the intrinsic factors associated with an improvement in health outcomes. Social determinants of health playing an important role as featured in Peter Archers article on addressing the social inequalities of health. This is true of developing countries along with certain population demographics in developed countries.

Care for their children and the choice of suitable childcare is an issue which mothers are concerned about. Uganda, specifically Kampala, along with other countries is facing a rapid increase in the number of daycare centers. . It is estimated that about 60% of mothers in Uganda work with children below the age of five. An interesting article from this region offers some insights into the quality of childcare settings. Professional childcare is needed in every community, from small towns to large cities. The need for daycare centers is expected to increase as an even greater number of parents enter or rejoin the workforce. This makes daycare facilities absolutely necessary especially in urban areas like Kampala which has a high working population. The challenge comes in the quality of care given to the child in terms of proper sanitation and hygiene in order to protect their health.

In Ireland we embarked upon a capital spending program that developed large childcare facilities that are a huge expense to families. The quality and hygiene of these facilities are strictly controlled by national legislation but really what are required in addition to strict monitoring is a tax relief scheme for families who use these facilities as they are hugely expensive and a barrier to more women entering the work force. Nordic countries have developed public policies, which global Governments should address in encouraging more women to participate in the work force.

Environmental Health students in some countries are presently on placement and Charles Shorten provides an overview of internships at West Chester University 30 years plus experience. For those countries who do not offer a placement component on the EH course this may be an opportune time to address the benefits for having such a facility. Whether the course offers a placement period or an internship this article demonstrates the success of such a program in developing the careers of graduates. The placement module and associated portfolio where students present 15 case studies is an integral component of the BSc Environmental Health course at Dublin Institute of Technology and played a vital role in establishing the mutual recognition of the award with the Chartered Institute of Environmental Health in the United Kingdom in October 2014. For this we are hugely grateful for in developing varying career paths for our graduates.

We hope to develop an advertising stream to the magazine in future publications so if you know of any companies who would be interested in advertising on a global stage please advise them to contact me in advance of the next edition. I hope you enjoy this edition and keep the articles coming as it is your contributions that contribute to the success of the magazine.

**Kathy Young**  
**IFEH Hon Editor. EHAI**

## **Determinants of under-five childhood diarrhea in Kotebe health center, Yeka sub city, Addis Ababa, Ethiopia: a case control study**

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### **Abstract**

Diarrheal disease is one of the major public health problems in children under-five years of age, especially in developing countries like Ethiopia. In order to investigate the association of socio demographic, behavioral and environmental factors with under five diarrhea, in an institutional based unmatched case-control study was conducted in Kotebe area, Addis Ababa.

A case in this study was a child under-five years of age visited Kotebe health center for treatment and a control was a child under-five years of age without diarrhea that came to the center for vaccination and treatment of other cases. A face-to-face interview based on a pre-tested, structured questionnaire was conducted with mothers/ caretakers with trained nurses. Binary logistic regression analysis was used to measure the association between dependent and independent variables, calculating odds ratios and 95% confidence intervals. Statistical significance was set at  $\alpha \leq 0.05$ . Multivariable analyses were applied to identify the relative effect of explanatory variables on the dependent variable. A total of 350 study subjects, including 117 cases and 233 controls, were recruited into the study. The study revealed that some factors remained independently associated with the risk of diarrhea, namely age of the children with adjusted odd ration (AOR) of 4.22 (1.36-13.14), maternal education AOR of 0.33 (0.16-0.65), supplementary feeding commencing time AOR of 0.30 (0.09-0.95) and hand washing after cleaning child bottom AOR of 0.59 (0.35-0.99); all with 95%CI and p-value  $\leq 0.05$ . The finding shows that investing in girls' education has substantial benefits on child health and should be considered for health intervention.

**Key words:** Unmatched case-control, Under-five childhood diarrhea, Kotebe, Addis Ababa

### **Introduction**

Although, diarrhea is a global problem, it is especially prevalent in developing countries due to poor environmental sanitation, inadequate water supplies, poverty and limited education (1). In developing countries, approximately 2 million people, the vast majority of whom are under-five children, die from diarrhea each year (2). Diarrhea is also associated with age of child, area of residence, maternal education, a source of water, toilet facility (3). The positive correlation between maternal education and child health outcomes is well established. A study in Bangladesh showed that a child whose mother completed primary school is 20% more likely to survive than a child whose mother has

not received any formal schooling, and a child born to a mother who attended secondary school is 80% more likely to survive (4). Diarrheal disease due to unsafe water and lack of sanitation are the biggest cause of morbidity and mortality in under-five children in the world especially in poor countries (5). A child dies every 15 seconds from diarrhea caused largely by poor sanitation and contaminated water supply (6). Behavioral factors of diarrhea include hand washing time, hand washing habit, supplementary feeding time, method of feeding, and measles immunization while behavioral factors associated with acute childhood diarrhea include lack of hand-washing, poor infant and young child feeding practices and lack of child immunizations (7). Therefore, the objective of this study was to assess diarrheal associated socio demographic, environmental and behavioral determinants of acute childhood diarrhea factors among children aged under- five years.

## **Methods**

Institutional unmatched case-control design was used to assess the determinants of under five diarrhea from February to March 2014 in Kotebe health center, Yeka sub city, Addis Ababa. The population of Yeka (346,664) is the largest of all sub cities in Addis Ababa. The proportion of under -five children in the Yeka sub city is 7.54% (8). Diarrhea prevalence in Addis Ababa city is 9.4% (8). The source population was under-five children attending at Kotebe health center during the survey period. Study population includes selected children less than five years of age who visited Kotebe health center. Study units were samples of under five children with diarrhea for cases and without diarrhea for controls.

The sample size calculation was based on the following assumptions: P1=proportion of diseased with disposal of refuse in the pit; P2= proportion of non-diseased with disposal of refuse in the pit. From a similar study conducted in Nekemte town with refuse disposal method as the main predictor of outcome (diarrhea), the sample was 42.86% of cases and 61.47% of the control (9). Therefore,  $P1=0.4286$ ,  $z1=1.96$  (95% CI) and  $P2=0.6147$ ,  $z2=0.84$  (power of 85%) the proportion of case and control was assumed to be 1:2. Ten percent non-response rate, the total sample was estimated using Epi Enfo™ 7.1.0.6 software as 350 (Cases=117, Control=233).

A structured questionnaire was developed to collect information on socio demographic and economic characteristics, environmental conditions and behavioral aspects for both cases and controls. Since the children were too young at under five years of age to be interviewed, verbal consent was taken from the mothers or caregivers.

Diarrheal children less than five years of age who visited Kotebe health center were recruited into the study after their parents expressed the willingness to participate in the study. To ensure that cases selected for the study represented a homogeneous entity, a definition of diarrhea was established. In addition, the age of a child was verified by cross-examining the information provided on their health and vaccination cards, or by the confirmation of the mother.

In this study, non-diarrheal patient children (*controls*) and those who came for vaccination with the age of less than five years admitted to Kotebe health center between February to March 2014 were selected into the study. The recruitment of

controls was carried out after their parents consented to participate in the study. Similar to the parents in the cases, the parents were more likely to be willing to cooperate than the parents of healthy children, thus minimizing bias due to non response.

The questionnaire was developed in such a way that all the possible variables that address the objective of the study were included. Data collectors were trained on interviewing techniques and closely supervised during data collection.

The pre-testing of the questionnaires was conducted on five percent of the questionnaires before data collection. After conducting pre-testing, some change in the questionnaire was made. On the measles vaccination status of children, in some cases mothers could not remember exactly whether children had vaccinated or not. Therefore, for example, mothers were asked whether (or not) their children had been vaccinated on the ninth month (ninth month vaccination). The completed questionnaires were checked every day during data collection for completeness, clarity and consistency.

In the study, the occurrence of diarrhea in a child was considered to be the dependent/outcome variable. Environmental factors (a type of water source, availability and ownership of toilet facility, solid and liquid waste disposal method), socio demographic (age, sex, religion, ethnicity, family size, educational status, and maternal job) and behavioral factors (hand washing, supplementary feeding commenced, and measles immunization) as exposure/independent variables.

The data were entered and analyzed using SPSS version 20. Descriptive statistics (frequencies, proportion, measures of central tendencies and variations) were used to describe the study population in relation to relevant variables. The odds ratio was computed to see the strength of association. To identify independent predictors of childhood diarrhea, only variables that were statistically significant during bivariate test were entered into multiple logistic regression models to control the effect of confounders.  $P \leq 0.05$  was considered statistically significant. Results were reported as the adjusted odds ratio (AOR) and 95% confidence intervals.

Before each interview, participants were provided with an explanation of the purpose of the study and its procedures. Participation (which includes mothers/caretakers) in the study was totally voluntary. Informed verbal consent was obtained from the mothers/caretakers of the children. Since the study was conducted by asking mothers of children recruited to gather information, the conduct of the study did not pose any health risk to the participants. Mothers who were found that their children were sick during the study time were consulted about the causes of the disease and her knowledge about it.

## **Results**

A total of 350 respondents were included in the study with a response rate of 100%. Of the total children, 184 (52.57%) were female. There were 55 (47%) males and 62 (53.0%) females in the case sample. Cases were mostly children between 6 and 11 months (41%). One hundred and twenty nine (36.9%) under five children were within 12-24 months age category. More than half of respondents 182 (52.0%) had 2-3 family size. The majority of the respondents, 265 (75.71%) were Orthodox Christian by religion and 199 (56.86%) were of Amhara ethnic group. One hundred and thirty eight (39.4 %) mothers had secondary education and 225 (64.29%) were housewives. Of the total cases, 32 (27.4%) fell in illiterate category and only 13 (11.1%) had college.

Table 1. Socio-demographic and economic characteristics of diarrhea among children under-five years of age in Yeka sub city, Addis Ababa, 2014 (n=350)

Variables	Category	Frequency	
		Number	%
Age of child (months)	<6	45	12.9
	6-11	115	32.9
	12-23	129	36.9
	24-59	61	17.4
Sex of child	Male	166	47.43
	Female	184	52.57
Family number	2-3	182	52
	4-6	158	45.14
	7-10	10	2.86
Religion	Orthodox	265	75.71
	Muslim	39	11.14
	Protestant	46	13.14
Ethnicity	Oromo	76	
	Amhara	199	56.86
	Tigrie	30	8.
	Guragie	32	9.14
	Others	13	3.71
Maternal education	Illiterate	81	23.0
	Able to read and write	27	7.70
	Primary (1-8)	71	20.30
	Secondary (9-12)	138	39.40
	College/University	33	9.43
Occupation of Mother	House wife	225	64.29
	Daily laborer	20	5.71
	Farmers	3	0.86
	Employee	97	27.71
	Others	5	1.43
Marital status	Married	316	90.3
	Single	9	2.6
	Divorced	13	3.7
	Widowed	6	1.7
	Separated	6	1.7

Table 2 shows environmental exposure characteristics of diarrhea among children under -five years. The majority of respondents, 302 (86.29 %), use tap as the main source of water. Only 1.43 % used unprotected well as a source of water. About 243 (69.43%) of the study population had shared latrine. Almost all respondents 349 (99.71%) had latrine. Most respondents 261 (74.57%) dispose solid waste in garbage, whereas only 3 (0.86%) in open fields. More than half, 180 (51.58%), of the respondents disposed liquid waste in sewage systems.

Table 2. Environmental exposure characteristics of diarrhea among children under -five years of age in Yeka sub city, Addis Ababa, 2014. (n=350)

Variables	Category	Total		
		Frequency	(%)	
Water source	Piped water	302	86.29	
	Protected well/spring	43	12.29	
	Unprotected well/spring	5	1.43	
Latrine Owned	Private	107	30.57	
	Shared	243	69.43	
Latrine Availability	No	1	0.28	
	Yes	349	99.71	
Disposal of household solid waste	Open field	No	347	99.14
		Yes	3	0.86
	Pit	No	332	94.86
		Yes	18	1.84
	Burning	No	283	80.86
		Yes	67	19.14
Disposal of household solid waste	Garbage can	No	89	25.43
		Yes	261	74.57
		Yes	261	74.57
Disposal of wastewater	Sewage system	No	180	51.58
		Yes	170	48.60
	Pit	No	186	53.14
		Yes	164	46.86

Table 3 presents selected behavioral characteristics in relation to under-five diarrhea. Out of those mothers/caretakers who started supplementary feeding for their children, 70 (20.1%) started before the child reached 6 months and 109 (31.2 %) at the age of 6 months. One hundred and thirty four(38.4%) of the mothers breastfed their children exclusively. That means they started feeding after six months. Only 36 (10.3%) did not

start any supplementary food before six months. Inconsistent with Ethiopian Demographic Health Survey (EDHS, 2011) (93.5%), the majority of respondents (95.6%) explained that their children were vaccinated for measles. Only 91 (26%) of the mothers/care givers had used only water to wash their hands, whereas 341 (97.43 %) used both water and soap to wash their hands.

Table 3. Behavioral factors for diarrhea among children under 5 years of age in Yeks sub city, Addis Ababa, 2014. (n=350)

Variables	Category		Total	
			Frequenc y	%
Supplementary feeding commenced	<6 (not yet started)		36	10.28
	Before 6 months		70	20
	On 6 months		109	31.20
	After 6 months		134	38.4
Measles Vaccination	No		11	4.3
	Yes		242	95.6
Hand washing substitutes	Water only	No	259	74
		Yes	91	26
	Water, Soap & substitutes	No	9	2.57
		Yes	341	97.43
	Others	No	348	99.4
		Yes	2	0.57
Hand washing time	After defecation	No	20	5.71
		Yes	330	94.29
	After cleaning child's bottom	No	167	47.71
		Yes	183	52.29
	Before handling food	No	12	3.4
		Yes	338	96.6
	Before feeding children	No	50	14.3
		Yes	300	85.7
	Other	No	342	97.71
		Yes	8	2.29

## **Factors Associated with the Occurrence of Childhood Diarrhea**

Table 4 presents selected socio-demographic, environmental and behavioral determinants of the mothers or care givers in relation to under-five diarrhea.

The occurrence of childhood diarrhea had association with the age of under-five children. In line with EDHS, 2011 diarrhea was most common among children age 6–23 months (23-25 percent). The crude odds ratio showed that diarrhea is highest in the age group 6-11 months Crude Odds Ratio (COR [95% CI] =4.66 [1.83-11.87]) and 12-23 months (COR [95% CI] =3.73 [1.47-9.50]). The reason for this might be, at these stages, the children could try to detect their surroundings so that they could be exposed to the case. It is least for 0-6 months of age. Compared with illiterate mothers, mothers with higher levels of education, such as secondary school, were associated with a lower occurrence of diarrhea. In other words, Odds Ratio OR decreased inversely in proportion to higher levels of education of mothers (COR [95% CI] = 0.37 [0.20-0.69]).

An association has been found between supplementary feeding time and the occurrence of diarrhea among under- five children. The odds of the occurrence of childhood diarrhea among children who started supplementary feeding before six months, was about four times [COR: 3.77, 95% CI: (1.60-9.20)] higher when compared with those less than six months and not yet started a supplementary food. An association has also been found between hand washing after cleaning the child's bottom and diarrhea among under five children [COR: 0.56, 95% CI:

Table 4. Factors associated with diarrhea among children under -five years of age in Yeks subcities Ababa, 2014 (n=350)

<u>Variables</u>	<u>Category</u>	<u>Case n (%)</u>	<u>Control n(%)</u>	<u>COR(95%CI)</u>	<u>AOR(95%CI)</u>
Age of child (months)	<6	6 (5.1)	39 (16.7)	1.00	
	6-11	48 (41.0)	67 (28.8)	4.66 (1.83-11.87)*	4.22 (1.356-13.14)†
	12-23	47 (40.2)	82 (35.2)	3.73 (1.47-9.50)*	3.09 (0.97-9.88)
	24-59	16 (13.7)	45 (19.3)	2.31 (0.82-6.48)	2.45 (0.66-9.10)
Maternal education	Illiterate	32 (27.4)	49 (21)	1.00	1.00
	Able to read and write	16 (13.7)	11 (4.7)	2.22 (0.92-5.41)	1.95 (0.75-5.09)
	Primary (1-8)	29 (24.8)	42 (18)	1.06 (0.55-2.03)	0.81 (0.39-1.70)
	Secondary (9-12)	27 (23.1)	111 (47.6)	0.37 (0.20-0.69)*	0.33 (0.16-0.65)†
	College/University	13 (11.1)	20 (8.6)	0.99 (0.44-2.28)	0.87 (0.35-2.18)
Supplementary feeding commenced time	<6 months (not yet started)	9 (7.7)	27 (11.6)	1.00	1.00
	Before 6 months	39 (33.3)	31 (13.4)	3.77 (1.60-9.20)*	1.16 (0.37-3.70)
	On 6 months	35 (29.9)	74 (31.9)	1.42 (0.60-3.34)	0.40 (0.12-1.27)
	After 6 months	34 (29.1)	100 (43.1)	1.02 (0.44-2.38)	0.30 (0.09-0.95)†
Hand washing after cleaning child's bottom	No	67 (57.3)	100 (42.9)	1.00	1.00
	Yes	50 (42.7)	133 (57.1)	0.56 (0.36-0.88)*	0.59 (0.35-0.99)†

\* p  $\leq$  0.05 on bivariate analysis

† p  $\leq$  0.05 on multivariate analysis

## Discussion

It was found that four factors were independently significant to the risk of diarrhea: age of the child Adjusted Odds Ratio [AOR: 4.22, 95% CI: (1.36-13.14)], maternal education [AOR: 0.33, 95% CI: (0.16-0.65)], supplementary feeding commencement [AOR: 0.30, 95% CI: (0.09-0.95)], and hand washing after cleaning child's bottom [AOR: 0.59, 95% CI: (0.35-0.99)].

From all socio demographic variables tested, age and maternal education remained significant after controlling other variables. The analysis showed that age of the child had a significant effect on diarrhea, which is consistent with a study in Ethiopia (10). This study observed that the cases were mostly children between 6 and 11 months of age, in which there were 48 cases, making up the highest rate (41% of the total). Number of cases decreased in older children.

In general, the study showed that diarrhea was significantly associated with children in the age groups 6 - 11 months and 12 - 23 months. This finding is in agreement with another study in Ethiopia (11) and Ghana (12). The risk of diarrhea decreases subsequently after 6 - 11 months. This is probably because the children begin to develop immunity to pathogens after repeated exposure (13).

The population policy of Ethiopia seeks to significantly increase female participation at all levels of the educational system. However, only 6% of females completed secondary education in Addis Ababa. The regression results supported the positive role of maternal education in reducing under five diarrhea. The odds of having diarrhea associated with mothers' education remained significant even after controlling for all other variables. Based on this analysis, those children whose mothers were at the secondary level of education are less likely to get diarrhea by 33% when compared to the reference illiterate.

It was found that mothers with higher education, experienced better chance of a child being free of diarrhea, which is consistent with a cross sectional study in Ethiopia (14). Maternal education was significantly associated with diarrheal in children. The study in Ghana (15) indicated that the prevalence of diarrhea was lower among children of more educated mothers (secondary or higher) than among children of mothers with no or primary education. Educated mothers practice good hygiene, better child feeding and weaning practices. A study in Bangladesh showed that a child whose mother completed secondary school is 80% more likely to survive (16). But according to another study in Ethiopia (17), educational status of mothers or care takers was not statistically significant in relation to diarrhea.

Children who were partially on breast milk were more likely to have diarrhea than children who were exclusively on breast milk (18). In this study there were 34 cases (29.1%) and 100 controls (43.1%) that started supplementary feeding after 6 months. According to multivariate analysis in Table 4, it was found that there was significant association between starting a supplementary food lately after 6 months and diarrhea. The finding of this study showed that children who were exclusively breastfed at the time of the survey were less likely to have diarrhea compared to less than six months' children who did not start supplementary food.

The odds of developing diarrhea was 59% less among children whose mothers washed their hands after cleaning their child's bottom. Studies showed the importance of hand washing in reducing the occurrence of childhood diarrhea (19).

## Conclusions

The results of the study showed that the factors, namely age of children, maternal education, supplementary feeding and washing after cleaning the child's bottom were significantly associated with diarrhea among children less than five year old.

Overall, the finding is important for health intervention and support the view that investing in girls' education may have substantial benefits for child health. In this study, it has been found that education provides a solution. Specifically, its secondary or higher level of education for girls is important in order to achieve improved childhood diarrhea problem.

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## **Environmental Health Internships at West Chester University: 30-Plus Years of Success Stories**

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### **Abstract**

West Chester University's Environmental Health Internship program began 32 years ago with its first graduate in 1981. Since then over 200 students have been placed in semester-long internships in private industry, consulting firms, hospitals, universities, research institutions, local health departments and departments of emergency services, state and federal environmental agencies and occupational safety and health agencies. Describing internships to prospective students is a strong recruiting tool and current students begin planning and interviewing for their internships up to a year in advance. Some completed internships have led to full-time employment positions that have lasted for many years. In other cases, WCU environmental health interns have moved up within their companies and have found themselves in positions to sponsor new interns themselves. This paper details evidence of success from (1) review of the complete database of internship years, sites and site supervisors; 2) email interviews with current interns and internship site supervisors; and (3) alumni interviews. While current students and site supervisors routinely report satisfaction with the internship experience, additional anecdotal input from program alumni a few years post graduation to mid-career also reflects a positive outlook on internships and the lessons learned by students in an employment setting. Evidence suggests that these internships set students on successful career paths and that this experience propels them to make positive impacts on the Environmental Health profession.

### **Introduction**

The internship, as practiced at the undergraduate level in various environmental health and other related disciplines, is widely viewed as a positive, hands-on foray into the working world for students, many of whom have no prior professional work history. The experience can be short, from only a few hours in duration as an "externship," or up to a full semester endeavor as the typical internship. The National Environmental Health Science and Protection Accreditation Council (EHAC) requires the following for all accredited baccalaureate environmental health programs (National Environmental Health Science and Protection Accreditation Council, n.d.):

*Field practicum or equivalent experience should encompass a minimum of 180-clock hours total. Students should be exposed to field equipment, data collection and data*

*interpretation. From this experience students should develop problem solving skills, learn to work as part of a team and gain an understanding of organizational dynamics. Environmental Health faculty should maintain liaison with governmental environmental control agencies, institutions and industries which can provide students with exposure to the applied aspects of environmental health. Alternatives to field practicum will be considered by the Council.*

Other related accrediting bodies value internships, e.g. the American Board of Engineering and Technology (ABET) requires an internship for its accredited safety degree programs. Ferguson (1998) made the case for establishing guidelines for such internships to maintain their academic integrity and usefulness to students and the internship site. A convenience sample of 14 safety faculty members indicated considerable variability in the following: internship prerequisites (GPA, courses), internship requirements (duration, weekly hours, number of sites), site requirements (assignments, supervision, compensation) and internship evaluation (assignments, grading, outcome assessments). The 10 recommended guidelines included sections for internship purpose, student criteria, site criteria, timing/duration of internship, orientation, evaluation, collaboration, legal issues for paid vs. non-paid interns, faculty coordination and program evaluation.

Various other models provide different experiences for students that mimic the internship. Brennan, Keeter, Riordan & Lackman (2005) described a 16-hr experience for meteorology students with supervisors from the National Weather Service. This experience was part of a larger course offered to senior undergraduates and graduate students, but it did emphasize mentor shadowing and participation in tasks such as analysis of weather maps and data, constructing weather summaries and disseminating results. They also participated in training sessions and high-impact weather events. LaFollette, Bellinger & Ronczkowski (2001) described the use of short (one to eight-hour) “externships” or “professional days” to accomplish the same goal: familiarizing the student with various environmental health worksites and tasks, with close mentoring by environmental health professionals.

In addition to internships arranged by faculty members for their students, various federal programs exist for the introduction of students to the rigors of environmental health work. The CDC sponsors an annual Summer Program in Environmental Health (SUPEH) that involves students with local, state and federal environmental health practice. A broad spectrum approach to environmental health (acknowledging the 14 technical content areas of the Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) exam) is stressed (Gerding & Kunz, 2011). Students appreciate the rigor of the program, especially as it enhances their technical, assessment, management and communication skills (Choo, Gerke, Sellers & Syed (2012). They learn that a complex mixture of activities make up the typical workload of the environmental health professional. Another federal program that was highly successful was the US EPA National Network for Environmental Management Studies (NNEMS). Because the NNEMS program has been discontinued, the USEPA website ([www.epa.gov/fellowships](http://www.epa.gov/fellowships)) now lists numerous fellowships and scholarships that would be suitable internship experiences for the well qualified student. Students can be encouraged to compete for internships with other programs such as the US Public

Health Service's Junior Commissioned Officer Student Training and Extern Program (JRCOSTEP), the Summer Internship Program at the National Institute of Environmental Health Sciences (NIEHS) or the new Federal Emergency Management Agency FEMA Corps for disaster preparedness, mitigation, response and recovery. Often, an internship can provide valuable input to a community-based research project that partners local universities with outside agencies. Cockerill (2010) described a broad-based interdisciplinary internship approach focused on an effort to educate the larger community about issues related to water quality and quantity in Western North Carolina. These students developed the same skills highlighted by the students in the SUPEH program (Choo, Gerke, Sellers & Syed, 2012): data collection, professional communication, organization of workload and data evaluation. Clearly, development of these skills applies to all internships.

Skills the environmental health intern must have upon beginning the internship include technical writing and public speaking; it is not realistic to expect the student to learn these while meeting all the technical and professional demands of the internship (Krinn, 1996). Of equal importance in the success of internship programs is the concept of added value to both the intern and the internship site. Internship site selection is very important; some programs require students to find their own sites, while in others, the faculty members find the sites.

The water supply field has acknowledged an upcoming industry-wide shortage of personnel and has suggested that internships should be made an important workforce development tool for new professionals (Mirvis et al., 2008). The American Water Works Association (AWWA) model for internships recognizes that exposure to a water supply career translates to experience in the field which ultimately develops expertise in the profession. Some positives relayed to students about a water supply career include good salaries, job security and a clear connection to the protection of public health. One cited problem with internships is their short duration. Assuring close supervision of interns, assignment of meaningful and appropriate work and direct, responsive evaluation of internship work are keys to success in the water supply industry. Mirvis et al. (2008) stressed building the internship program into the overall organizational workforce strategy.

McGlothlin (2003) conducted an extensive survey of occupational health and safety graduates to ascertain their satisfaction with the internship experience, in ABET accredited programs. Several factors were evaluated; female students tended to view the internship experience as more important than male students. Type of work was not a significant variable, but the type of worksite was. The survey showed a wide range of intern salaries and this variable was the single independent variable most predictive of intern satisfaction. Personal responsibility and preparation of the student, a common theme in the internship literature, also played a role in McGlothlin's interpretation of the results. A strong set of recommendations for the student, the internship site and the university was developed that could be adapted for EHAC accredited programs as well. Internships don't always lead to a full-time job for the student, at the internship site, but they sometimes can. The economy and approval for hiring can be a big stumbling block; Berg (2010) described just such an example in Plano, Texas where an environmental health intern completed her internship, graduated and sought work with her internship site, a local environmental health department. The agency wanted her

but the budget would not allow the hire. Only upon a retirement did the agency receive the final approval and the former intern was awarded a full-time position.

Murray State University (MSU) requires a semester-long internship for its occupational safety and health students (Fender & Watson, 2005). In a survey of MSU interns from 2003, students were asked about the most positive and negative elements of their internship experiences. Gaining “real world experience” was a common positive, while not being given sufficient or meaningful work was a common negative. As also cited by McGlothlin (2003), students agreed that assuming personal responsibility in preparing for the internship, both in coursework and in gaining knowledge and perspective about the work site before the internship, was a key ingredient in success. Students in this survey overwhelmingly concluded that their internship had a positive impact on the development of their careers.

The internship program in the Environmental Health Program at WCU has similar elements found in the internship experiences of other BS environmental health, environmental science and occupational safety programs but it has not been systematically examined. This paper reviews the placement site and type for WCU interns over the last 30 years. It also examines the reflections about internship experiences from environmental professionals who are mid and early career; internship supervisors and immediate past/current student interns. This analysis can help shape internship policies for environmental programs seeking accreditation or otherwise considering adding or modifying an internship in their curricula.

## **Methods**

Two tools were used to characterize the internship experience of WCU students over the last 30+ years: a database of internship sites and an informal email questionnaire sent to a convenience sample of environmental health alumni and internship supervisors.

### **Database Review**

Since its inception in 1981, the Environmental Health Program at WCU has placed over 200 student interns at various internship sites with private industry, government and non-profit employers. While records were kept for most internship placements, those of one retired faculty member were not available for this analysis. Records included student name, internship semester, internship site and site supervisor. Current contact information was available for some but not all interns, sites and site supervisors. The total number of completed records was 140. Internship site records were used to characterize the variety and type of environmental health internships completed.

### **Email Interviews**

Four groups were established to characterize the WCU internship program, including (1) Mid-career EH Professionals/Alumni, 5 – 20 years post BS; (2) Early Career EH Professionals/Alumni, 1 – 5 years post BS; Current /Immediate Past Interns; 0 - 1 years post BS and (4) Internship Supervisors. Six representatives from each group were contacted by email and asked to reply to a short set of questions including, with slight modification for each group as needed:

Questions to Interns/Alumni:

1. What was your own experience as a student intern? Can you describe the type of work you did, the type of internship site that hosted you and anything about your interaction with other professionals?
2. What skills or lessons did you learn in your internship that have stayed with you over the years?
3. Did your internship play a positive role in shaping your early career, and if so, how?
4. What advice would you offer to future interns to help them get the most out of their internship to help them launch and continuously grow their professional careers?

Questions to Internship Supervisors:

1. What was your own experience mentoring student interns? Can you describe the types of work you assigned, the types of internship site that you represented and anything about your interaction with WCU EH interns?
2. What skills or lessons, if any, did your interns learn in their internship that you expect they are now using in the early-mid years of their careers?
3. Do you estimate that the WCU EH internship plays a positive role in shaping their early careers, and if so, how?
4. What advice would you offer to future interns to help them get the most out of their internship to help them launch and continuously grow their professional careers?

Responses were collected and used to characterize the perceptions of these interns and their supervisors.

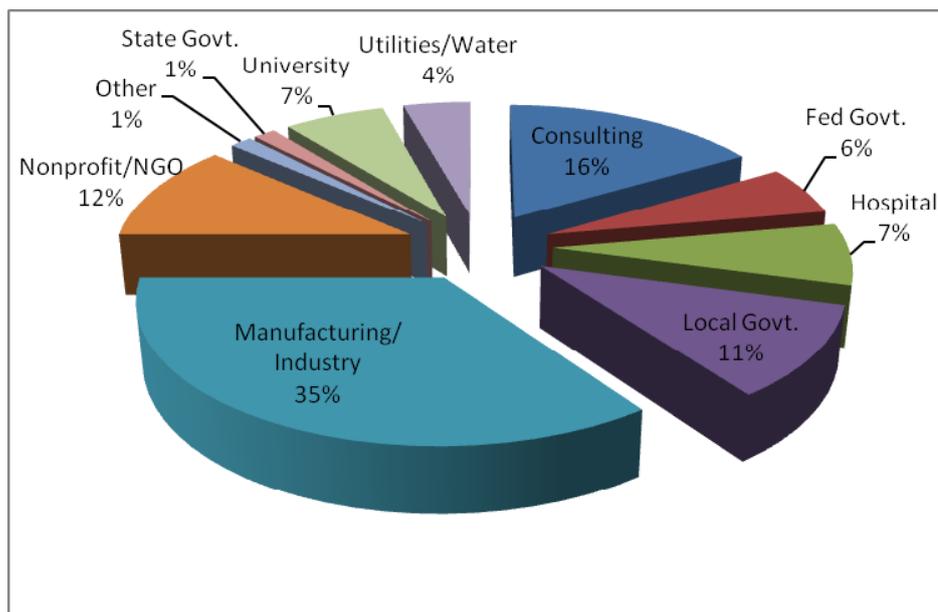
## **Results**

### **Database Review**

From a database of all 203 environmental health internship from 1981 – 2014, entries for student name, internship site name and internship supervisor were collected if available. Placement sites for several students prior to 2000 (approximately 60) were not known due to a loss of records. While more interns were placed in the five years from 1996-2000 than any other comparable period, the 2011 – 2015 period is on track to be one of the most significant in the environmental health program's history for placement of interns. Figure 1 shows the trends in internship placement at WCU. In fact, because the internship has been a requirement for graduation since the inception of the program and it is the last requirement of the degree after all courses are completed, this figure also reflects total BS degree completions.

Since the beginning of the program, environmental health students have been matched with an internship site that is best suited to their ability, career and professional goals. Internships were divided into 10 categories including manufacturing/industry, local government, state government, federal government, hospitals, universities, consulting firms, utilities/water, nonprofit/NGOs and other. Placements by category are shown in Figure 2.

**Figure 1.** Completed BS Environmental Health internships from the Environmental Health Program at WCU, 1981-2014.



**Figure 2.** Internships by Type of Site. From the internship database, site type was assigned to one of 10 different categories including manufacturing/industry, local government, state government, federal government, hospitals, universities, consulting firms, utilities/water, nonprofit/NGOs and other.

Over half of the internships were served in the private sector. More interns were placed in manufacturing/industry (35%) than any other sector, primarily in response to student's

interest in industrial hygiene practice. Major industrial sectors in the SE Pennsylvania area include pharmaceutical, petroleum refining, metals and battery manufacturing and aerospace. Consulting firms ranked second at 16%, perhaps because of the relatively good pay, variety of work available and proximity of several large and small environmental consulting firms to WCU. According to McGlothlin (2003), internship salary was one of the leading factors in internship satisfaction with the experience, again supporting the student's choice to work in manufacturing/industry or consulting. While some students have been offered full-time positions with their internship site following the internship, there are no records to assess how commonplace this practice is.

Nonprofit/NGO placements offer some unique opportunities for undergraduate interns, especially because the small staff and focused mission of these organizations often allows the student to dig deeply into a particular problem or process. At 12% of all placements, many WCU interns have opted for these sites which usually offer little or no pay. In exchange, students have polished laboratory research skills, writing, networking and communications skills, making them more competitive than students without internships. The combined government categories (federal, state and local) comprised 18% of all internships; these included local health departments, environmental protection agencies, emergency management agencies, occupational safety and health agencies and soil/water conservation agencies. As with the nonprofit/NGO sector, many of these were unpaid or relatively poorly-funded, stipend-based positions. Two federal programs of note, the US Public Health Service's JRCOSTEP and the CDC's SUPEH program have not yet hosted a WCU intern; as a regional school, most WCU interns prefer to remain close to their home institution although students are encouraged to apply for these competitive programs.

### **Email Interviews**

Four groups were established to characterize the WCU internship program and responses were received from representatives of each group. Comments are presented in Tables 1 – 4 for alumni/students and in Table 5 for internship site supervisors. Several patterns emerged but there was a consistent tone of satisfaction, pride and confidence that the internship program was instrumental in shaping and growing environmental health careers.

The first question for alumni and current interns was "What was your own experience as a student intern? Can you describe the type of work you did, the type of internship site that hosted you and anything about your interaction with other professionals?" Responses given in Table 1 showed a variety of types of work, both in the field and in office settings, all in paid internships. Alumni reported that they engaged in mentor shadowing, experienced active involvement in meaningful work, worked on a variety of assignments and conducted laboratory and research work. Professionalism and respect were mentioned as well as collaboration and problem solving.

The second question asked "What skills or lessons, if any, did you learn in your internship that you will use or expect to use in the coming years of your career?" Replies are shown in Table 2. While the responses to this question were mixed, the themes of timeliness, confidence, preparation and training emerged.

The third question, "Did your (will your) internship play a positive role in shaping your early career, and if so, how?" elicited overwhelmingly positive replies, as shown in

Table 3. For at least three of the alumni interviewed the internship became a formal job offer which they accepted; these mid-career EH professionals are still working in the types of jobs where they interned. Networking and the enduring, developed professional relationships that began with their internships were cited as key contributors to the success of their careers.

All groups were asked the question “What advice would you offer to future interns to help them get the most out of their internship to help them launch and continuously grow their professional careers?” As shown in tables 4 and 5, both alumni and internship site supervisors advised future interns to take the internship seriously, to show responsibility through their actions, to ask for assistance when needed and to seek new and unfamiliar experiences. Important quotes included “be professional and be available” and “be humble.” Openness to learning was seen as important by both alumni and site supervisors.

Table 1. Question 1: What was your own experience as a student intern? Can you describe the type of work you did, the type of internship site that hosted you and anything about your interaction with other professionals?

<i>Mid-career EH Professionals/Alumni (5 – 20 years post BS)</i>	<i>Early Career EH Professionals/Alumni (1 – 5 years post BS)</i>	<i>Current /Immediate Past Interns (0 - 1 years post BS)</i>
<p>Site: Large environmental consulting company</p> <p>My 13 weeks were split between time in the field soil sampling along gas pipelines and time in the office providing project support for mid to senior level risk assessors. I pretty much hit the ground running approximately one week after the spring semester ended. I believe a big factor that helped me land my internship was that I had received the 40-hour HAZWOPER training while attending classes at WCU. Not many people had the HAZWOPER when they graduated. I received a significant amount of OTJ training during my time in the field and in the office from my co-workers and colleagues.</p>	<p>Site: Pharmaceutical company</p> <p>Working with my site supervisor was a very rewarding opportunity. The work was conducted at professional level and business etiquette was prevalent. I did not perform busy work but applicable industrial hygiene and safety initiatives. The facility was a biomedical research facility with state of the art technologies. The colleagues that I worked with offered advice regarding the work and business ideals.</p>	<p>Site: University Hospital EHRS office</p> <p>This has been a truly wonderful experience for me. In a large research institution, there are numerous opportunities to work with different aspects of the environmental health field. While I mainly worked with the Industrial Hygiene team, I was able to meet, and in some cases shadow, staff members from Occupational Safety, Biosafety, and Environmental Programs. I really enjoyed working in an academic environment as well. EHRS has to find balance between two main goals; the promotion and support of research and development in one of the country's leading educational institutions, as well as the promotion and support for the health and safety of all university staff, faculty, and students. This task, which is difficult at times, calls for a great deal of creative thinking, problem solving, and teamwork and I really enjoyed being part of it.</p>
<p>Site: Large environmental consulting firm.</p> <p>I started after my junior year as a full-time summer intern. I was kept on as a part-time employee while I completed my final year at WCU and was then able to</p>	<p>Site: Pharmaceutical company, laboratory</p> <p>During my internship I gained instrumental experience that I still reference and think about to this day. Although performing R&amp;D in an Oncology lab did not directly relate to Environmental Science, it did indirectly in many ways and the employees there made it a point to incorporate these into the internship. They did this by having me shadow the</p>	<p>Site: Major Hospital Complex</p> <p>As of right now my internship is mostly observing what the senior research safety team members do as daily tasks. I worked with the research safety team in two different research buildings. So far</p>

<p>complete my senior internship there as well. Following my internship, I was offered a full-time position, which I graciously accepted. I was assisted in all aspects of risk assessment and learning how to excel in a consulting environment.</p> <p>I was given training that would benefit me for years to come. I had opportunities to learn from countless individuals with decades of environmental consulting experience, and most importantly, I was given an opportunity to see if my career path was truly where I wanted to be.</p>	<p>Industrial Hygienists that ensured lab safety around the facility, showed me the animal testing facilities which related to toxicology, and had me complete my own research project and present it to fellow scientists, helping me gain technical writing and presentation skills. Everyone I worked with was so helpful and informative, I felt that they were completely invested in my experience there.</p>	<p>we have conducted laboratory surveys, making sure they are following the rules set by OSHA for laboratory safety. Since my first day I was treated as one of the team. I never felt like I was just a student or observer, I actually was called upon to help do weekly activities and help with training sessions.</p>
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Table 2. Question 2: What skills or lessons, if any, did you learn in your internship that you will use or expect to use in the coming years of your career?

<i>Mid-career EH Professionals/Alumni (5 – 20 years post BS)</i>	<i>Early Career EH Professionals/Alumni (1 – 5 years post BS)</i>	<i>Current /Immediate Past Interns (0 - 1 years post BS)</i>
<p>Site: Large environmental consulting company</p> <p>The greatest lesson learned was that you need to build confidence and trust from your colleagues.</p>	<p>Site: Pharmaceutical company</p> <p>A major lesson/skill that has stayed with me from the internship was completing assigned projects on time. Management and supervisors want to see projects delivered when assigned. This was critical in not only developing as a student but also in the professional work place. Another skill is accountability, once a task is assigned you are responsible not only when it</p>	<p>Site: University Hospital EHRS office</p> <p>During my time there I was also able to observe routine safety audits of laboratories and facilities, attend training sessions for ergonomics, hazard communication, and confined space and sit in on webinars covering a variety of topics. I also completed personal training sessions for radiation safety, laboratory safety, waste management, and entrance to animal facilities, which are required for Penn employees based on their department.</p>

	<p>is completed but how. The quality of work must fit the management's expectations and this was a great learning experience.</p>	
<p>Site: Large environmental consulting firm.</p> <p>During my internship, I learned an immeasurable amount of computer skills, report writing, database management, EPA, state, and regional guidance and policies, field work, and ecological and human health risk assessment methodologies. Everything that I was taught during my internship has formed the foundation of where I am today in my career and I continue to expand upon that experience still.</p>	<p>Site: Pharmaceutical company, laboratory</p> <p>My internship taught me that the Environmental Health degree allows me to apply myself to a wide range of careers. It's not limiting like some degrees are. Skills I used today that my internship taught me are the importance of working well in a group environment that at times can be stressful, how to balance a large work load, ask questions when I'm not sure, problem solve when issues arise, and my favorite; to take pride in your work. I left the internship very impressed with how invested every single worker was in their work, it was personal, and they were proud of what they did. I loved that about my internship and found that very inspiring.</p>	<p>Site: Major Hospital Complex</p> <p>Being so early in my internship I have little to add for this question. As of right now, I am learning how to use my chemistry background while doing lab walk-throughs and surveys. I am always asking questions about why things are in the places they are, and it is really helping me understand my schooling of chemistry by using it in everyday life.</p>

Table 3. Question 3: Did your (will your) internship play a positive role in shaping your early career, and if so, how?

<i>Mid-career EH Professionals/Alumni (5 – 20 years post BS)</i>	<i>Early Career EH Professionals/Alumni (1 – 5 years post BS)</i>	<i>Current /Immediate Past Interns (0 - 1 years post BS)</i>
<p>Site: Large environmental consulting company</p> <p>Yes, I was hired as a full-time employee by my internship site at the conclusion of my internship. I've been working with the same core group of people since 1997. I attribute this to the relationships I developed during my internship.</p>	<p>Site: Pharmaceutical company</p> <p>The internship played a critical and positive role in developing my career. The internship gave me real world experience in the workforce and it really showed when going to interviews. The experience is what companies want and this internship, although short, played a critical role in gaining work experience. It also showed me that I enjoy this position in health and safety. I am very grateful for the opportunity the internship supplied.</p>	<p>Site: University Hospital EHRS office</p> <p>The experience was great for me and I know it will help me in my future career. I made great contacts and applied things from classes to work projects. I was able to approach the tasks at work very well. I feel like I had the background from our classes that I needed to tackle work assignments. A job would come up (chemical consolidation, monitoring for methylene chloride, assessing new euthanasia processes) and I knew how to deal with it. Anticipate, recognize, evaluate, etc. I was able to gather data, evaluate data and present findings, suggest controls, and plan on follow-ups. It was very satisfying and I learned a great deal.</p>
<p>Site: Large environmental consulting firm.</p> <p>The most positive role that my internship played in my career was opening a door. I may have otherwise never had the opportunity to work in the consulting environment. My internship was a perfect fit for my skill set and my long-term career goals. The network and the contacts that I made through my internship continue to prove</p>	<p>Site: Pharmaceutical company, laboratory</p> <p>Absolutely! I felt very out of my element when I first started and remember thinking "what did I get myself into, this stuff is way over my head". After I completed my internship I felt very confident that I could handle unfamiliar tasks and wasn't afraid to do so.</p>	<p>Site: Major Hospital Complex</p> <p>Definitely. Building connections with people who are so closely related to my career of choice is always a positive. I also feel like I am learning new things everyday at my internship, and I believe it will continue to be that way throughout its entirety.</p>

<p>beneficial even now, fourteen years later. I am certain that the efforts put forth by the EH faculty to provide their students with the best internship experience possible, is why I have been so successful and satisfied with my career.</p>		
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Table 4. Question 4: What advice would you offer to future interns to help them get the most out of their internship to help them launch and continuously grow their professional careers?

<i>Mid-career EH Professionals/Alumni (5 – 20 years post BS)</i>	<i>Early Career EH Professionals/Alumni (1 – 5 years post BS)</i>	<i>Current /Immediate Past Interns (0 - 1 years post BS)</i>
<p>Site: Large environmental consulting company</p> <p>My advice would be that responsibility and punctuality go a long way to show colleagues that you take you internship seriously.</p>	<p>Site: Pharmaceutical company</p> <p>The internship is a stepping stone, it is not just a part of college but a step into the professional workforce. Students should take their internship seriously and treat it as their first job out of college. I asked questions every day and my colleagues were thrilled that I asked rather than stayed quiet. You can learn a lot of things by talking to colleagues and asking them questions regarding your profession. Be involved as much as possible in your internship, I would try as much as possible to go to meetings for risk assessments or job hazard analysis, met with directors and scientists. This is where you get to learn how a company works together and that you profession influences other parts of the company. Last but not least, be happy, having a positive attitude and being young in the work force was noticed, it seemed to have an effect on employees around you.</p>	<p>Site: University Hospital EHRS office</p> <p>I found that keeping old class notes and textbooks was helpful because I had built up a resource file to refer to for different projects. I even reviewed some old assignments and found them helpful in work projects. I also think students should really think about what kind of work experience they want to learn more about and start thinking about internship opportunities early on. They should also ask a lot of questions and not be afraid to do so. The main point of the internship is to learn and gain experience and the people I have had the privilege of working with are very supportive of this. I imagine most of the supervisors that agree to hire interns from our program would be just as helpful. Having a mentor is an invaluable resource in any field and I hope that future students take advantage of that opportunity.</p>
<p>Site: Large environmental consulting firm.</p> <p>My best advice to future interns is to be humble. Take advice and guidance from anyone who is</p>	<p>Site: Pharmaceutical company, laboratory</p> <p>My advice is to intern at a company that is going to challenge you; do not merely settle on an internship just</p>	<p>Site: Major Hospital Complex</p> <p>Be professional and be available. Your attitude greatly reflects who you are in the workplace. One of the first</p>

<p>willing to offer it. Be willing to do whatever tasks are presented to you, no matter how remedial or trivial they may seem. A willingness to start at the ground level and show that you are worthy of advancement will prove immeasurable. A willingness to make yourself available above and beyond the minimal requirements will not go unnoticed. Lastly, I will recommend taking advantage of the contacts that you have made during your time at WCU.</p>	<p>because it was easy to find or it fills the requirement. Once you find yourself working as an intern, constantly learn and take on unfamiliar tasks, even if you have to ask for them. The more you gain from your internship the more you will be able to put on your resume, therefore the more impressive you will look to a potential employer vs. other recent grads.</p>	<p>things if was told while I was getting interviewed was that they (my supervisors) were happy I wasn't coming in with a false sense of entitlement like a lot of young people usually do. Because in reality, you have to earn respect. Just be respectful, be helpful and always ask a lot of questions because you are there to learn.</p>
<p>Table 5. Perceptions/Comments of Internship Site Supervisors</p>		
<p><i>Question 1:</i> What was your own experience mentoring student interns? Can you describe the types of work you assigned, the types of internship site that you represented and anything about your interaction with WCU EH interns?</p>		
<p><i>Site: Major Hospital Complex</i></p>	<p><i>Site: Industrial/Manufacturing</i></p>	<p><i>Site: County Emergency Services Agency</i></p>
<p>I found it very rewarding to share my professional experiences and stories to an engaged audience. Often times, the general public doesn't know what EH&amp;S professionals do on a daily basis, so when a student is interested and passionate, it's very gratifying to share those experiences. We often assign IH equipment based tasks so they get to research a standard/guideline, touch and maintain equipment, work with data and help prepare a report. This gives them a full-circle IH experience. Some examples have included</p>	<p>The mentoring of student interns interested in Environmental Health &amp; Safety careers has been a refreshing experience for me. It's always a pleasure to have a young professional hopeful around, especially those possessing the knowledge instilled in them by the University prior to their arrival. The interns are exposed to all activities such as the creation and implementation of programs, collecting and analyzing data for various regulatory permit reporting requirements. It is my opinion that we represent the actual, hands-on experience that interns may not always have the opportunity to take part in. Nothing is veiled in secrecy or left to guess. The Interns I have had the pleasure of working with have been top-notch individuals. They have a thirst for knowledge that I have not seen from young men and women in a long time. WCU interns are more than happy to accept a challenge and it's gratifying to watch them morph from college interns to "seasoned"</p>	<p>The interns produced by the West Chester University Environmental Health (WCU EH) program have been easy to work with, enthusiastic about their internship, and thirsty for knowledge. The interns have done projects centered on the faith-based community's role in disasters and resource identification and typing. The interns have dressed and acted professionally at all times, easily adapted to the environment</p>

<p>noise monitoring in the physical plant and formaldehyde sampling in labs.</p>	<p>young professionals.</p>	<p>they worked in, and asked intelligent questions about the field and their projects.</p>
<p>Question 2: What skills or lessons, if any, did your interns learn in their internship that you expect they are now using in the early-mid years of their careers?</p>		
<p>I like to think they have learned how to conduct themselves in a professional manner and pay attention to the details. We have our interns shadow us in as many situations as possible. Some have experienced some heated conversations, but this has allowed for them to observe how to conduct ones self and stay true to the topic without getting emotional.</p>	<p>The skills learned are only limited by the Intern’s willingness to ask the questions and experience the activities. WCU interns have not shied away from any opportunities or situations thrown at them. The skills ranged from the mundane everyday tasks to the chance occurrence, rarely repeated or duplicated. Collecting of air emissions data and weekly plant-wide ESH inspections; assisting in the transferring of wastes into shippable containers and the implementation of satellite waste collection points are examples of the day-to-day regimen here. The coordination and launching of a “Zero Waste to Landfill” initiative was an activity accomplished by a WCU intern this year at our facility. The program while experiencing some expected “growing pains” is paying immediate dividends. The “lessons” learned here are those that can be and are experienced daily in the business world. These lessons only serve to fill in those gaps that school cannot, and it is my hope that those lessons and skills can be applied almost anywhere the college graduate chooses. They can look back and have a level of satisfaction knowing they were able to retain that knowledge and that it assisted them in their careers.</p>	<p>I think the most valuable skill is working in an office environment. Additionally, they have a better understanding of overall project management and how individual pieces of a project play an important role in the overall goal.</p>

Table 5 (continued). Perceptions/Comments of Internship Site Supervisors		
Question 3: Do you estimate that the WCU EH internship plays a positive role in shaping their early careers, and if so, how?		
<i>Site: Major Hospital Complex</i>	<i>Site: Industrial/Manufacturing</i>	<i>Site: County Emergency Services Agency</i>
Absolutely! The vast majority of our WCU interns have been the best we've ever had. And they seem to have more success in gaining employment before leaving us compared to those from other universities.	Without a doubt, the Internship program for Environmental Health established at WCU pays off immeasurable dividends in the development of a student for his or her career. The hands-on experience here can only serve to advance the Intern ahead of others just coming out of school. I like to use the term "Plug n' Play" when referring to a WCU Intern completing this program. He or she can immediately step into an entry-level ESH position almost anywhere with little learning curve to overcome, aside from the uniqueness of the organization they are working at. The Internship makes them self-starters and self-motivators. Businesses today have very little time to expend on the tutelage of "professionals"—they want those employees ready to take on the tasks assigned them out of the gate. That's what the WCU Internship program does—it creates candidates ready to move into the workplace and contribute from their first day.	I believe the internship experience plays a positive role in shaping their early careers. The internship experience gives them the real-world exposure and experience that so many employers are looking for today. I believe the internship experience teaches them valuable lessons that are able to be taught in an academic environment. The internship experience provides students an opportunity to put theory into practice in a "safe" environment.
Question 4: What advice would you offer to future interns to help them get the most out of their internship to help them launch and continuously grow their professional careers?		

<p>Be open to learning about anything and everything! I've often told them that you need to be willing to accept that you may be knowledgeable about everything and an expert in nothing. Part of being an IH is being a "forever-student".</p>	<p>Don't be afraid to fail or make mistakes; these like the successes are learning experiences and only serve to make one better. Maintain "peripheral" vision when pursuing a career; don't be so focused on what is in front of you that you miss out on an opportunity just out of view. Just because someone says "We've always done it this/that way" doesn't make it right; take the time to describe why the change is good and will benefit those you are working with. Always look for that next opportunity to grow; there's no law or rule that says you have to stay at the same place forever. Most importantly TRUST YOUR GUT; Your gut will never lie to you.</p>	<p>The best advice I can offer is be ready, open, and willing to learn. You'll gain extremely valuable lessons from an internship experience – especially the opportunity to apply theory learned in the academic environment to practical, real-life situations.</p>
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### Discussion and Conclusions

The internship database and interviews with former interns and site supervisors offer direct evidence of the success of the internship program for WCU environmental health students. Some of the keys to the success of our internship program include: student engagement, the duration of the internship, the skills developed during the internship, the technical and communication skills developed in prior classes, the added value provided to the supervisor and site, the assignment of students to faculty with expertise in the student's area of interest and most importantly, careful selection of site supervisors.

Mini-internships or externships can provide brief encounters by students with EHS professionals. Our WCU industrial hygiene class incorporates an externship and engages pairs of students with industrial hygiene mentors. The mentor provides a tour of the worksite and is interviewed by the students. This externship provides a "teaser" that helps the student realize how important it is to have an internship. Throughout advising and other environmental health coursework, the value of the internship is emphasized and students start to envision their own internship. By the time the students start their internship, they are fully engaged. As shown in the internship supervisors' comments in Table 5, WCU students are enthusiastic learners during their internship experiences.

As noted, EHAC requires at least a 180 hour internship for accredited BS programs. The Environmental Health Program at West Chester University (WCU) meets and exceeds this minimum with a full semester, 12-credit, 540-hour internship requirement and with this format, we overcome the problem of too short duration indicated by Mirvis et al. (2008). A longer internship provides more time for students to hone the skills cited in tables 1, 2 and 3 (the intern comment section) and emphasized by various authors and accrediting bodies. As noted in Tables 1, 2 and 3, these skills include for example: data collection, evaluation and management, oral and written

communication, organization of workload, participation in meetings, observational skills, use of regulations and the development of computer skills.

As Krin (1996) noted, students need excellent oral and written communication skills before the internship experience. Our internship supervisors also expect excellent technical skills. WCU interns must complete all coursework prior to their internship, thus assuring that they have received the requisite skills to succeed. Writing emphasis courses and a public speaking course are required general education courses and our environmental health curriculum provides many different communication experiences along with detailed technical skill development. This strong base of skills allows the student to flourish in the internship. Our HazWOPER class, industrial hygiene, risk assessment, water quality and environmental regulations class requirements have been cited frequently by students and supervisors as important preparation for internship. A strong base of skills also allows the internship supervisor and site to have an excellent "return on investment" (ROI) that often leads to extending the internship even longer than 540 hours and guarantees that supervisors will agree to sponsor future interns. As demonstrated in Table 5, the students' enthusiasm provides a personal ROI for the supervisors.

To fully assure success, site and supervisor selection are key ingredients. Although internships in some other programs require the student to find his/her own site, West Chester University environmental health faculty members make the connections for the students. Linking the student's passion with the appropriate faculty member is essential. For example, a student interested in a water quality internship is advised by a faculty member with this expertise. While most environmental health internship programs use full-time faculty to oversee student interns, Ronczkowski, LaFollette & Bellinger (2004) made a compelling argument for a full-time internship site coordinator position. They cited consistency in student preparation, anticipation and evaluation as major advantages, as well as providing a single point for students and internship sites to contact with questions or concerns about internships. While there are definite strengths with this model when large numbers of interns are placed at once, WCU places interns in all semesters (fall, spring and summer) and the total number of interns at any one time, for any faculty member, rarely exceeds four. This is a manageable workload and it keeps the faculty solidly connected to the student, the professional mentor and the environmental health profession throughout the educational process. We believe that our one on one matching of the student's interest with the specific faculty member with that expertise is the best model for our program.

The faculty internship advisors select site supervisors who offer proven value to the education of the new environmental health professional. Supervisors are either well known by the faculty or are recommended by colleagues whose judgment we value. New supervisors are interviewed in person or by phone and thorough explanations about the internship requirements for the supervisor, student and faculty member are provided. Intern supervisors grasp the importance noted by Mirvis et al. (2008) of building the environmental health workforce and take their roles very seriously. The requirements of daily student activity logs that are submitted weekly to the site supervisor and faculty advisor, and meetings during the internship among the faculty, supervisor and student have significantly minimized any complaints of the problem cited by Fender & Watson (2005), of lack of meaningful work. Our interns almost always

provide significant work contributions to the site. As seen in Tables 2, 3 & 5, our site supervisors instill a solid work ethic, teamwork, passion, confidence, accountability and encourage networking, punctuality and life-long learning. Many interns have indicated that they feel pride in their work yet gained humility too because they now know what they need to continue to learn as professionals.

It is well known that an internship is a fine preparation for the real work world. In various programs, internships lead to jobs and the economy is an important determinant of whether this will occur. Sometimes, as noted by Berg (2010), the intern has had to wait awhile to have their intern status converted into a job. At least two such recent examples have been experienced by WCU students; one in private industry where the student was brought on full time after almost a year of temporary, full-time status, and one in a university setting where the former intern is still employed by the campus Environmental Health Department after a year, albeit in a temporary status. Whether or not an internship leads to a job at that internship site, from the evidence provided in Tables 1-5, it is clear that our EHAC accredited program and our internship program lead to career success for our students.

In the future, we will continue to assess our internship program and fine tune it as needed. We hope to broaden the scope of the sites by encouraging more participation in e.g. CDC, FEMA, USEPA and USPHS programs that we have not as yet tapped. In conclusion, our internship program is successful as documented by the evidence provided by our students, alumni and site supervisors. Our keys to success include: 1) the enthusiasm and preparation of our students, 2) the 540 hour minimal duration of our internship that allows time for the student to gain needed skills and a ROI for the supervisor and site, 3) the linkage of a student's interests with an appropriate faculty member and most importantly, 4) the careful selection of superb site supervisors who are excellent mentors of our students

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## **Knowledge and practices on sanitation and hygiene in daycare centres in Kampala District, Uganda**

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### **Abstract**

#### ***Background***

Although there is an increase in demand for daycare services in Kampala, the state of sanitation and hygiene in these centers across the country remains unknown. Improved sanitation and hygiene in such centres has been shown to help in the prevention of diseases like diarrhea and pneumonia among children. This study therefore set out to assess the knowledge and practices on sanitation and hygiene in daycare centres in Kampala district, Uganda.

#### ***Methodology***

A cross sectional study involving quantitative data collection methods was employed. A total of 24 daycare centres were involved in the study. Data was collected using a questionnaire and an observational checklist. Snowball sampling was used to select and interview 4 respondents from each centre hence a sample size of 96 respondents. Data entry and analysis was done in Epi Info 7.1.3.1

#### ***Results***

Over half of the respondents (54%) had received training relevant to child care. Their knowledge on specific diseases related to poor sanitation and hygiene varied with 63.5% of them aware of diarrhea and only 32.3% mentioning cholera. Majority of respondents said that they washed hands before and after handling food (84%), and visiting the toilet (79%). Although all day care centres (100%) had hand washing facilities, 45.8% of them did not have soap at the time of observation and only 8.3% had both hot and cold water. Most daycare centres (95.8%) did not have handwashing procedures or reminders displayed near the hand washing facilities.

#### ***Conclusion***

Daycare centre caretakers' practices on sanitation and hygiene were good. However, daycare centres should provide soap for handwashing and display reminders of handwashing procedures near handwashing facilities.

### **Introduction**

Uganda, specifically Kampala, is facing a rapid increase in the number of daycares

(Kakungulu, 2013)(Riley, 2012). It is estimated that about 60% of mothers in Uganda, with children below the age of five, work (Nandudu and Kara, 2013). Professional childcare is, therefore, needed in every community, from small towns to large cities. The need for daycares is expected to increase as even a greater number of parents enter or rejoin the workforce (Nandudu and Kara, 2013). This makes daycare centres absolutely necessary especially in urban areas like Kampala which has a high working population. The challenge comes in the quality of care given to the child in terms of proper sanitation and hygiene in order to protect their health. The state of sanitation in Kampala is very poor. The available sanitation facilities both in commercial and residential areas cannot meet the needs of the ever increasing population (Sanna, 2008). This already poses a threat to daycare centres within the city. This is worsened by absence of comprehensive policies that could guide daycare owners in running daycares in a good sanitary condition. If quality care is not provided, children may be exposed to the risk of acquiring various diseases some of which can be fatal.

Improved water sources reduce diarrhea morbidity by 21%; improved sanitation reduces diarrhea morbidity by 37.5%; and the simple act of washing hands at critical times in daycare centres can reduce the number of diarrhea cases by as much as 37% (WHO, 2000). The sanitation and hygiene in institutions in Uganda where children spend most of their time is inadequate. A study conducted in 20 districts of Uganda including Kampala revealed that floors in most primary (80%) were wet and dirty. Toilet surroundings were littered with feces/urine in 2/5 primary schools and 1/3 of them were littered with feces – an indication of poor sanitation culture (Jitta, 2006). If that is the case with primary schools, a case of understanding pupils, it is necessary to assess the state of sanitation prevailing with toddlers. This study assessed the knowledge and practices on sanitation and hygiene in daycare centres in Kampala district, Uganda.

## Methods

The study was cross-sectional in design and involved the use of quantitative data collection methods. The study site was Bukoto, a residential area with entertainment and a few social services which include supermarkets, clinics and clubs, in Nakawa division, Kampala district - Uganda's capital city. The study units were day care centres and the study population were caretakers in these centres who had direct contact with children.

A total of 24 day care centres were visited and 96 caretakers who worked in these centres interviewed for the study. For each day care centre, 4 caretakers were interviewed. In case there were less than 4 care takers in a day care centre, all those who were present were interviewed and for day care centres with more than 4 caretakers, snowball sampling was carried out to select those to be interviewed. All daycare centres located within Bukoto and preprimary schools that had a daycare facility were included in the study.

A semi structured questionnaire with both open and closed ended questions and an observational checklist were used for collecting data. The questionnaire was used to conduct interviews with the caretakers and the observational checklist was used to assess the availability and working condition of the facilities within the daycare centre. Collected data was entered and analyzed using Epi Info version 7.1.3.3 statistical

package. Univariate analysis was carried out and the results are presented in form of percentages, tables and figures.

Permission to carry out the research was obtained from Makerere University School of Public Health and the relevant local authorities and day care centre management. Informed consent from the respondents was sought before the interview and the names of the daycare centres or caretakers were not indicated on the questionnaires to protect daycare centres. Collected data was kept under lock and key and was only accessible to the Principal Investigator to maintain confidentiality.

## Results

### ***Demographic characteristics of respondents***

Majority of respondents (90%) were females while Christians (89.7%) dominated the workforce. The largest number of respondents (39.6%) had attained tertiary education. Over half of the respondents (54%) had training that was relevant to child care. This included trainings like Certificate, Diploma or Degree in Nursery teaching or Early Childhood Education. Respondents who were single (62.5%) were more than those who were married (Table 1).

*Table 1 Demographic characteristics of respondents*

<b>Variable</b>	<b>Category</b>	<b>Frequency (n=96)</b>	<b>Percentage (%)</b>
Religion	Christian	86	89.6
	Muslim	9	9.4
	Others	1	1.0
Sex	Female	86	89.6
	Male	10	10.4
Education Level	Primary	2	2.1
	Secondary	30	31.3
	Tertiary	64	66.7
Marital Status	Married	39	37.5
	Single	60	62.5
Training relevant to day care	Yes	52	54.2
	No	44	45.8

All the daycare centres were privately owned and more than half (63%) were licensed. Most of them (59.4%) had ever been inspected by an Environmental health inspector on more than one occasion.

### ***General hand hygiene and diaper knowledge and practices***

Although only 24% of the caretakers had received training regarding proper hand washing, all of them acknowledged the need for washing hands. The hand washing training had been organized by the day care management, government and other

organizations for 67%, 8% and 25% of the caretakers respectively. However, since the rest (75%) did not have formal handwashing training, they did not know the proper procedure for washing hands.

Most caretakers (84.4%) stated that they knew at least one disease that could result from poor hygiene. Regarding knowledge on specific diseases, 63.5% were aware of diarrhea while 32.3% mentioned cholera. Very few (6.3%) respondents mentioned skin or diaper dermatitis. The largest percentage of caretakers (53.1%) said diapers ought to be checked for wetness in 1 hour or less. In addition, most participants (69.8%) specified that diapers should be changed immediately when wet or soiled or within 2 hours regardless of their state. Majority of respondents (84%) washed their hands before and after handling food and visiting the toilet (79%). When caretakers were asked about their children's hand washing practices, majority (91.7%) said that children washed hands before and after feeding.

Most daycare centres (75.0%) used disposable diapers for containing children's excreta. However, their practices varied; some (45.8%) did not let the children stay in diapers for the whole day especially for case for daycare centres handling older children who needed potty/toilet training rather than a whole day in diapers. Others (54.2%), however, did let the children use diapers and checked for wetness at varying times. Most (61.5%) day care centres changed diapers either every two hours or less or whenever they were wet or soiled.

### ***Food hygiene practices***

Half (50.0%) of the daycare centres permitted children to come with food mainly because they could not offer some varieties of meals requested by parents and also for their convenience. Those that did not permit this had varying reasons; majority (91.7%) said they did not trust the safety of the food and were unwilling to take responsibility for any illness that could arise while (8.3%) said they did not have food warming appliances.

### ***Facility and equipment hygiene practices***

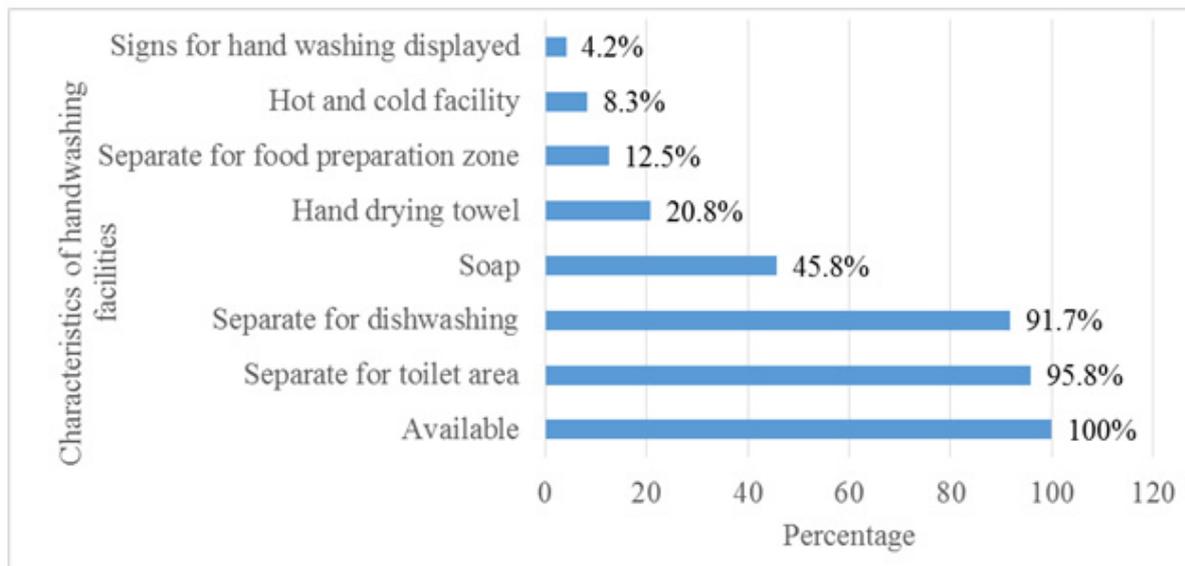
Majority of daycare centres (58.3%) only considered it necessary to clean toilets in the event of soiling (Table 2).

*Table 2 Frequency of toilet cleaning*

<b>Number of times toilets were cleaned per day</b>	<b>Frequency (n =24)</b>	<b>Percentage (%)</b>
Whenever soiled	14	58.3 %
Once everyday	6	25.0 %
More than twice a day	3	12.5 %
Twice everyday	1	4.2 %

Most of the daycare centres (95.8%) had separate toilet facilities for staff and children. Most staff toilets (91.7%) for the daycare centres were clean. All the toilets which were soiled belonged to institutions that either had a primary or secondary section in addition to the daycare. Majority of daycare centres (62.5%) had a toilet to child ratio of less than or equal to 1:10.

Most of the kitchens (95.8%) were clean at the time of observation. Regarding when cleaning was done, most day care centres (66.7%) had their kitchens cleaned whenever they were dirty. All the kitchens were a considerable distance from the toilets and laundry rooms. Most daycare centres (92%) routinely cleaned and disinfected their toys. The cleaning was done at various intervals. Half (50%) of them did this weekly. Of the 19 daycare centres which handled younger children for which a diaper changing area was required, only 3 had one. Majority of daycare centres (83%) had a garbage disposal facility. Only (50.0%) of these, however, were maintained in a good state as they had a covering lid that was in use. Only 41.7% daycare centres had an animal area enclosed within the facility and most (70%) had it separated from the children's playground. All daycare centres (100%) had hand washing facilities which were functioning properly although only (8.3%) had both hot and cold water and 45.8 provided soap at the hand washing stations (Figure 1). Majority of daycare centres (95.8%) did not have any handwashing procedures or reminders displayed near the hand washing facility and none had a food preparation sink with a splash guard.



**Figure 1 Features of hand washing facilities**

## Discussion

### **Demographics and Knowledge of caretakers on sanitation and hygiene**

Just as noted in other countries like Canada and the United States in Census (2004), the work force in daycare centres within Bukoto is predominantly female. All the caretakers attained some level of education. This is an encouragement to the future of daycare given the fact that more than half of the respondents had an education relevant to childcare. Childcare provided by caretakers who are educated is more likely to be reliable. The knowledge of the caretakers in regard to hand washing, however, was inadequate. They did not know the proper procedure for washing hands. In addition, most did not know that it was vital for them to wash hands after cleaning or handling the garbage, after playing with the children, before and after giving medication or applying a medical ointment, or after handling bodily fluids, from sneezing, wiping and blowing noses. This means there is still a danger of possible illness due to poor handwashing. Handwashing at critical times in daycare centres has been shown to reduce the number of diarrhea cases by as much as 37% (WHO, 2000). If hands are not washed well, there is a risk that illnesses may occur. Indeed, even if hands are washed but not washed the right way or kept clean thereafter, illness may still be a result (Donowitz, 1996). There is therefore need for training in proper handwashing skills for the staff in daycare centres. Hand hygiene is the most important and common way to reduce the spread of infection. Several studies have shown that improperly cleansed hands are the primary carriers of infections (Hawks et al., 1994; Soto et al., 1994). Deficiencies in hand hygiene have contributed to outbreaks of diarrhea among children and caregivers/teachers in child care centres (Hawks et al., 1994). In other countries where child care centres have implemented hand hygiene training program, the incidence of diarrheal illness has decreased by 50% (Soto et al., 1994).

Since the findings revealed that the children washed hands at the same times with their

caretakers – before and after meals and after visiting the toilets – this could be an indication that the children are learning from their caretakers. Studies demonstrate a reduction in upper respiratory symptoms when frequent and proper hand hygiene practices were incorporated into a child care centre's curriculum (Soto et al., 1994; Roberts et al., 2000). Hand hygiene after exposure to soil and sand will reduce opportunities for the ingestion of zoonotic parasites that could be present in contaminated sand and soil (Palmer et al., 1998).

A large proportion of respondents knew diarrhea and cholera as the diseases that could result from poor hygiene. This demonstrated that they had good knowledge concerning the most common conditions resulting from improper sanitation and hygiene. The big proportion of caretakers stated that diapers should be checked for wetness within an hour and when wet, soiled or within at least 2 hours. This is in line with the recommendation by Healthy Children (2010) that diapers should be checked for wetness and feces at least hourly, visually inspected at least every two hours, and whenever the child indicates discomfort or exhibits behavior that suggests a soiled or wet diaper. Diapers should be changed when they are found to be wet or soiled. This is because frequency and severity of diaper dermatitis is lower when diapers are changed more often. Prolonged contact of the skin with urine, feces, or both will lead to irritant contact dermatitis (Shelov and Altmann, 2009).

### ***Facility hygiene practices***

The result that daycare centres with primary and secondary schools had soiled toilets, places a contrast between the hygiene practices in primary or secondary schools with that in daycare centres. A study carried out in 20 districts of Uganda found that most toilets of primary schools (80%) were wet and dirty, toilet surroundings were littered with feces/urine in 40% primary schools and (33.3%) of them were littered with feces – an indication of poor sanitation culture (Jitta., 2006). This could indicate that as children grow older, teachers cease paying closer attention to their hygiene practices. If the children at primary or secondary level were not well trained hygienically in their infant stages, they would carry on with such practices. Separation of daycare toilets from primary or secondary schools would be helpful as it would reduce chances of children utilising the dirty toilets.

The study established that most daycare centres (67%) cleaned their kitchens in any event of dirt, all the kitchens were separated from the toilets and laundry rooms and most (95.8%) were clean during the study. This indicates a good practice in taking precaution to avoid any form of contamination to the food. Most daycare centres (92%) considered it vital to routinely clean and disinfect the toys, such that the risk of diseases is reduced. Toys and other objects in child care areas have played a role in the transmission of diseases in child care settings (Greiner and Leduc, 2008). Toys can spread disease when children put them in their mouths, touch the toys after putting their hands in their mouths during play or eating, or after toileting with inadequate hand hygiene.

The facilities regarding diapers in daycares were inadequate since (86.8%) lacked a diaper changing area. This implies a great risk to the health of the children because of a

possibility of cross-contamination of rooms. It is therefore important that the institutions consider providing a diaper changing area where there is none; and those that have one ensure that it is separate from other rooms.

The result that most daycare centres (70%) that kept animals placed the animal area a good distance away from the children's playground indicates good knowledge and practice on children's hygiene when in proximity with animals. This is because the risk of injury, infection, and aggravation of allergy from contact between children and animals is reduced. According to Hansen (2004), staff of a childcare facility must plan carefully when having an animal in the facility.

It was a positive observation that all daycare centres (100%) had hand washing facilities which were in good working condition. However, 45.8% of daycare centres did not have soap available at handwashing stations at the time of inspection and only 8.3% had both hot and cold water. This would make these facilities ineffective and inefficient. This is because only thorough handwashing with soap for at least twenty seconds using comfortably warm, running water (between 60°F and 120°F) removes organisms from the skin and allows them to be rinsed away (Palmer et al., 1998). It is thus advisable for these institutions to avail these written guidelines for the caretakers. In addition, soap at the hand washing facilities should be availed and reminders for hand washing displayed near the hand washing facilities.

### Conclusions

The daycare centre caretakers were knowledgeable and aware of some important sanitation and hygiene practices like knowing proper times for changing diapers; and diarrhea and cholera being a result of poor sanitation and hygiene. However, there was still a gap in hand washing during the critical times. Training would ensure that they understand the various critical times when they should wash their hands.

The daycare centres had suitable sanitation facilities such as toilets, handwashing facilities, and those for garbage disposal. However, some facilities such as diaper changing areas were inadequate and situated in positions that allow for possibility of cross-contamination with areas of children's playroom or sleeping rooms. The operating condition of some of the sanitation facilities was also inadequate; they lacked soap at handwashing stations. There is therefore a need for more effort for the daycare centres to provide functional facilities that will carry out their intended purpose.

Overall, the caretakers' practices on sanitation and hygiene were good. Nonetheless, daycare centres should endeavor to provide soap for handwashing and display reminders of handwashing procedures near handwashing facilities.

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## WORLD ENVIRONMENTAL HEALTH DAY CELEBRATIONS 2014 HELD IN UGANDA BY MAKERERE UNIVERSITY ENVIRONMENTAL HEALTH STUDENTS' ASSOCIATION



### INTRODUCTION AND BACKGROUND

Makerere University Environmental Health Students' Association (MUEHSA) is an association that was formed in 2003 to support the interests of students and practitioners of Environmental Health in Uganda. Some of the activities carried out by MUEHSA include: supporting continuing professional development through annual conferences, seminars, public exhibitions, involvement in community development programs like health education sanitation and hygiene promotion among others. MUEHSA has held scientific conferences every year since 2003 with the most recent held on 11<sup>th</sup>-12<sup>th</sup> April, 2014.

The International Federation of Environmental Health declared 26<sup>th</sup> September as the World Environmental Health Day (WEHD) which is celebrated each year. The theme for the 2014 WEHD was "Addressing Environmental Health Inequalities". This day is celebrated all over the world and in Uganda, students of environmental health from Makerere University School of Public Health (MakSPH) marked the day with a community health improvement intervention in Kamwokya, one of the suburbs of Kampala, the country's capital city. The students under their umbrella body, MUEHSA identified Kifumbiira slum in Kamwokya because of its poor environmental health status. Kifumbiira slum has a high population density of up to 1,200 people, with poorly planned low cost housing characterised with heavy congestion. The narrow pathways in the slum are littered with refuse and the drainage channels serving this swampy marshland

are also filled with refuse causing blockages, stagnation of waste water, nuisances of smell and mosquito breeding. Some residents lack latrines hence dispose their excreta in polyethene bags which they later dump into drainage channels. Some of the residents access water for domestic use from springs whose ground water is likely to be contaminated predisposing them to diarrheal diseases such as cholera. Many infants in the zone have also been observed to suffer from nutritional disorders such as protein-energy malnutrition which is an indicator of inadequate nutrition within the community. The field of Environmental Health focuses on environmental factors that affect man's health and how they could be modified to prevent ill health or promote health. The identification of these factors in Kifumbira zone fostered a need to implement preventive health measures for their mitigation. The students therefore set out to improve the solid waste management, nutrition, reproductive health, sanitation and hygiene of the community. To implement this intervention, various stakeholders were involved including: MakSPH, Kampala Capital City Council Authority (KCCA), community leaders, Village Health Teams (VHTs), Homisdallen Primary School and various media houses.

### **Community health interventions on WEHD 2014**

#### **1. Clean up exercise**

The students desilted and removed refuse that blocked the flow of wastewater through the drainage channels. Rubbish was collected using hoes and spades, gathered together with brooms, collected in wheelbarrows and transferred to central collection points along the roadside. Rubbish which was stored in the plastic bags was transferred directly to the roadside to be collected by a KCCA garbage collection truck.

#### **2. Health education**

Health education on antenatal care, family planning, solid waste management and improvement of nutrition was carried out in the community. Pregnant women were encouraged to attend all antenatal care and ensure nutritious feeding based on a balanced diet to boost their immunity and that of infants since they are vulnerable to diseases. Consequences of poor sanitation and the need to improve sanitation and proper hygiene were also taught.

Pupils of Homisdallen Primary School were encouraged to: practice basic sanitation and hygiene practices such as hand washing with soap after visiting latrines, observing body hygiene, hair combing, keeping their finger nails short, washing their underwear often and avoid littering their environment.

#### **3. Community health meeting**

After the clean-up exercise and health education, the group converged at Homisdallen Primary School and were joined by the pupils of the school and residents of the different zones in the area. A session to reflect on the activities carried out during the day was held and was graced by the representative of the Director of the Public Health Department, KCCA. He thanked the students for their initiative and also encouraged

the VHTs to keep fulfilling their responsibilities. The activities of the day were covered by various local media houses.

### **Conclusion**

The event organised by the Environmental Health students to celebrate WEHD 2014 was a success and contributed significantly to the health status of Kifumbira zone. The residents were delighted and appreciative of the work well done and obtained a new perspective on managing their own community health challenges in the future.

### **Acknowledgments**

MUEHSA takes gratitude and special recognition of the support rendered by the following parties without whom the activities carried out to mark the WEHD would not have been a success: Public Health Department, KCCA; Office of the Dean, MakSPH; the Chair, Department of Disease Control and Environmental Health – MakSPH; The Director Family Health Research and Development Centre (FHRDC) - MakSPH; VHTs of Kifumbira-Kamwokya; Students of Bachelors of Environmental Health Science of MakSPH; Homisdallen Primary School administration and the media houses of Bukedde, Channel 44, UBC and Star TV, the Observer, Monitor and New Vision Newspapers. These were all instrumental in the achievement of the objectives of the celebrations.

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**Pictorial presentation of what transpired during the celebrations of the World Environmental Health Day.**



***Environmental health students unblocking onto the one of the drainage channels truck***



***KCCA work men loading garbage***



***Students unblocking a drainge channel***



***Students with some mothers after sensitization***



***Students removing garbage from a channel in drainage***



***Students sweeping one of the paths***

## **Global Perspectives on Health-based Piped Drinking Water Quality Standards**

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### **ABSTRACT**

Safe drinking water is essential for human health and survival. In order to manage quality of piped drinking water with a view to protecting and promoting human health, regulatory agencies in various countries prescribe their own standards for chemical, microbial and radiological contaminants. Piped drinking water that is not meeting these standards is deemed as unsafe for human consumption, and is likely to cause outbreaks of waterborne diseases or contribute to background rates of diseases on different time scales.

In the recent years, concerns have been raised about emerging contaminants such as pharmaceutical compounds, personal care products and engineered nanoparticles in piped drinking water.

In order to understand the various approaches that a regulatory agency could undertake to prescribe health-based standards for various piped drinking water contaminants, a review of relevant literature was carried out. The review also included identification of a regulatory approach to address contaminants for which no health-based standard could be prescribed. The findings of this review are presented here.

### **INTRODUCTION**

According to WHO Guidelines [1], the nature and form of drinking water quality standards may vary among countries and regions. At the national or federal level, the environmental agencies, public health agencies or other dedicated drinking water agencies usually prescribe standards for quality of piped drinking water. These standards may be enforced by the national agency, state agencies, or local health agencies within individual regions.

Different countries use different terminologies to describe piped drinking water quality standards, which may be enforceable or non-enforceable, depending upon how these standards are prescribed through available legislative, administrative and policy mechanisms. Some of the other terms used to describe standards by the regulatory agencies and international organizations are, inter alia - *targets*, *specifications*, *guidelines*, *concentrations* and *maximum contaminant levels*, which may form part of the regulations, advisories, codes, directives and documents promoting best practices

[1, 2, 3, 4, 5]. For the purpose of this review, where applicable, the term ‘standard’ may mean any of these terms.

## PIPED DRINKING WATER QUALITY STANDARDS

Examples of piped drinking water quality parameters, which are traditionally regulated or for which guidelines are issued by the regulatory agencies or international organizations, are shown in Table 1 below.

**Table 1: List of parameters**

Type	Example
Aesthetic and physico-chemical parameters	pH, colour, odour, turbidity, conductivity, etc. <u>Note:</u> These parameters are often not considered as health-based parameters. However, some substances of health concern also have effects on the taste, odour or appearance of drinking water [1]. If aesthetic quality of water is compromised, it may affect consumer confidence.
Chemicals	Contaminants from water treatment chemicals: Aluminium, acrylamide, epichlorohydrin, etc. Contaminants from plumbing: Benzo[a]pyrene, copper, lead, iron, etc. Disinfectants and disinfection-byproducts: Bromate, bromoform, bromodichloromethane, chlorine, chloroform, monochloramine, etc. Inorganic chemicals, including heavy metals: Arsenic, mercury, chromium, fluoride, sulphate, chloride, etc. Organic chemicals, including cyanotoxins and pesticides: Alachlor, atrazine, chlorpyrifos, ethylbenzene, microcystin-LR, permethrin, etc.
Microorganisms and parasites	<i>Cryptosporidium, E. coli, giardia, naegleria fowleri, rotaviruses, total coliforms, schistosoma, vibrio cholerae, etc.</i> <u>Note:</u> <i>E. coli</i> and <i>coliforms</i> may serve as indicator organisms for faecal contamination.
Radiological parameters	Gross alpha, gross beta, Iodine-131, Plutonium-239, Strontium-90, tritium, Uranium-238, etc.

## APPROACHES IN SETTING THE HEALTH-BASED STANDARDS

An example of an approach in establishing health-based standards for various piped drinking water quality parameters is shown in Table 2 [6].

**Table 2: Steps in establishing health-based standards**

Review of- International guidelines and standards adopted by other countries Studies on risk to human health
Further review by the regulatory agency, to assess relevance to local situation
Consultation with external experts and stakeholders
Adoption of the standards by the regulatory agency through new regulations or amendments to the existing regulations
Periodic review and revision of the standards through steps 1 to 4, as necessary

### World Health Organization/WHO's Guidelines

Many countries use the WHO's Guidelines for Drinking-water Quality as the reference point for establishing their own piped drinking water quality standards. For example, one study suggested that drinking water regulations from South American countries had been, to various extents, influenced by one or another edition of the WHO Guidelines [7].

The WHO Guidelines describe reasonable minimum requirements of safe practices to protect the health of consumers and derive numerical guideline values for constituents of water or indicators of water quality [1].

The approaches used in WHO guidelines to derive health-based guideline values (GVs) or targets are as follow [1].

- GV's for many chemicals represent the concentration that does not result in any significant risk to health over a lifetime of drinking water consumption, viz. 70 years.

#### *Chemical parameters*

- For chemicals having demonstrable threshold dose for toxic health effects, and for which tolerable daily intake (TDI) values are available, the GV's are derived based on TDI using the equation:

$$GV = \frac{TDI \times \text{body weight} \times \text{fraction of the TDI allocated to drinking water}}{\text{daily drinking water consumption}}$$

Where default assumptions are made for body weight and daily drinking water consumption; viz. 60kg adult consuming 2 litre/day, 10 kg child consuming 1 litre/day and 5kg bottle-fed infant consuming 0.75 litre/day.

- For chemicals considered to be carcinogens, GVs are set at the concentrations associated with an estimated upper-bound excess lifetime cancer risk of  $10^{-5}$  (or one additional case of cancer per 100,000 population ingesting drinking water for 70 years).
- Where a chemical is unlikely to occur in drinking water, or where there are inadequate scientific data on risk assessment, the health-based GVs have not been established for such chemicals under the WHO Guidelines.

#### *Microbial parameters*

- Since it is not practical to set targets for all potentially waterborne pathogens, which are diverse in characteristics, behaviour and resistance, the targets involving reference or indicator organisms and criteria for water treatment performance can be set. For faecal contamination, *E. coli*. or thermotolerant coliform bacteria, could be used, which should not be detectable in any 100 ml of drinking water sample.

#### *Radiological parameters*

- The approach used for radiological parameters is that the screening levels for gross alpha and gross beta are provided based on individual dose criterion of 0.1 millisieverts in a year. Although finding levels of gross alpha or beta activity above screening values does not indicate any immediate risk to human health, it should trigger further investigation to determine the radionuclides responsible and the possible risks, taking local circumstances into account.

#### EU Council Directive 98/83/EC

The Council of the European Union (EU) has issued a Directive, which provides parameters and parametric values for various microbiological, chemical and indicator parameters for drinking water, based on the WHO guidelines and the opinion of the European Commission's Scientific Advisory Committee [8].

When translating the Drinking Water Directive into their own national legislation, Member States of the EU can include additional requirements e.g. regulate additional substances that are relevant within their territory or set higher standards for these parameters [8].

#### Standards/guidelines adopted by individual countries

In the U.S.A., under the Safe Drinking Water Act, the US Environmental Protection Agency (US EPA) sets legal limits on the levels of certain contaminants in drinking water [9]. The legal limits reflect both the level that protects human health and the level that water systems can achieve using the best available technology. The US EPA has established its unique strategy whereby it determines whether a contaminant should be regulated based on peer-reviewed science, including data on: how often the

contaminant occurs in the environment; how humans are exposed to it; and the health effects of exposure [10]. In year 2010, the US EPA announced a new drinking water strategy under which contaminants are addressed as groups rather than one at a time, so that enhancement of drinking water protection can be achieved cost-effectively [11].

Other countries, which have issued standards and guidelines for various piped drinking water quality parameters, include Australia, Canada, Japan, Singapore, United Kingdom, etc. [2, 4, 5, 12, 13].

#### Review, adoption and periodic revision of health-based standards

The regulatory agency should review the available data mentioned in the preceding sections to assess relevance of the parameters and their proposed limits to consider the local situation. This should be followed by consultation with external experts and various stakeholders, during which the need to adopt a more conservative limit for any parameter should also be identified.

Subsequently, the regulatory agency may prescribe the standards through new regulations or amendments to the existing regulations. The standards should be periodically reviewed and revision of the standards through steps 1 to 5 should be considered, as necessary [6].

### **UNREGULATED CONTAMINANTS**

It is virtually impossible to set health-based standards for all drinking water contaminants, as there are numerous chemicals and microorganisms, which can possibly be present in contaminated water. Advancements in analytical technologies have also led to detection of many contaminants at trace levels. Contaminated piped drinking water may thus contain chemicals, for which a regulatory agency may not have prescribed any standards under its regulations or guidelines.

There have been several reports on the risk of pharmaceutical compounds, personal care products and engineered nanoparticles in piped drinking water [14, 15, 16, 17, 18].

In one study, seventeen pharmaceutical compounds including human and veterinary antibiotics (macrolides, sulfonamides, thiamphenicol, nitroimidazoles, trimethoprim), nonsteroidal anti-inflammatory drugs (salicylic acid, diclofenac), etc. were detected in tap water [19].

According to WHO [14], there are currently few systematic monitoring programmes or comprehensive studies available on human exposure to pharmaceuticals from drinking-water. Therefore, a key challenge in assessing the potential human health risk associated with exposure to very low concentrations of pharmaceuticals in drinking-water is the limited occurrence data available for the diverse group of pharmaceuticals

in use today and their active metabolites. Current observations suggest that it is very unlikely that exposure to very low levels of pharmaceuticals in drinking-water would result in appreciable adverse risks to human health, as concentrations of pharmaceuticals detected in drinking-water (typically in the nanogram per litre range) are several orders of magnitude (typically more, and often much more, than 1000-fold) lower than the minimum therapeutic dose. Hence, the development of formal health-based guideline values for pharmaceuticals in the WHO's Guidelines is currently not considered to be necessary.

Similarly, for a number of personal care products, there are no international guidelines or health-based standards set by national authorities in various countries.

In case of nanoparticles, detection of synthetic particles is a major challenge [20]. According to a report prepared by the Food and Environment Research Agency for the Drinking Water Inspectorate in the United Kingdom (U.K.), there are significant gaps in the current knowledge regarding the use, environmental fate and exposure of engineered nanoparticles in the U.K. environment [21].

## **LEGISLATIVE APPROACH FOR UNREGULATED CONTAMINANTS**

In order to address the presence of non-regulated contaminants in drinking water, a regulatory agency could make use of specific provisions within its legislation, requiring the water suppliers to sell or supply safe piped drinking water as part of regulatory compliance – rather than attempting to establish water quality standards for every known contaminant. The descriptive statements that a regulatory agency may use in its legislation will depend upon the local situation. As an example, the EU Directive [8], states that 'Member States shall take the measures necessary to ensure that water intended for human consumption is wholesome and clean,' and that such water shall be wholesome and clean if it 'is free from any micro-organisms and parasites and from any substances which, in numbers or concentrations, constitute a potential danger to human health.'

Thus, in case of any occurrence of unfortunate piped drinking water quality incident, or an outbreak of waterborne disease, if the water is found to contain an unregulated contaminant at a level that is considered to pose potential danger to human health, the regulatory agency can still exercise the option to initiate enforcement action against the water supplier.

Additionally, in order to require the water suppliers to implement comprehensive risk assessment and risk management practices, the regulatory agency may mandate the preparation of water safety plans (WSP) by the suppliers [22]. According to WHO Guidelines [1], WSP include approaches that are most effective means of consistently ensuring the safety of a drinking water supply. The elements of a WSP build on the multiple-barrier principle, the principles of hazard analysis and critical control points and other systematic management approaches that may help to manage the risk to human health from unregulated parameters.

## CONCLUSION

The common approaches in prescribing health-based standards for traditional set of parameters (such as heavy metals, pesticides, *E. coli.*, etc.), cannot be applied to certain emerging contaminants due to the challenges in conducting risk assessment and lack of sufficient scientific data. Hence, to address the risk arising from such unregulated contaminants, a regulatory agency could use descriptive statements in its legislation, requiring the water suppliers to sell or supply safe piped drinking water, and implement water safety plans as a part of preventive approach. The exact wording of the descriptive statements should be decided based on the local situation.

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