

Master of Public Health

Applied Practice Experience

by

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submitted in partial fulfillment of the requirements for the degree

MASTER OF PUBLIC HEALTH

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List of Abbreviations

AOI	Area of Inquiry
HICD	Human and Institutional Capacity Development
HFDN	Human Health, Food Safety, Diets and Nutrition
ILRL	International Livestock Research Institute
LMICs	Low- and Middle-Income Countries
MIT	Markets and Innovation Translation
PI	Principal Investigator
PDM	Production and Disease Management
SPSS	Statistical Package for Social Sciences
USAID	United States Agency for International Development
WaSH	Water, Sanitation, and Hygiene

Chapter 1 - Portfolio Products

The Innovation Lab for Livestock Systems was established by Feed the Future to conduct long-term research and capacity-development activities, primarily through applied research that is multidisciplinary, integrated, and competitively funded. The International Livestock Research Institute (ILRI) and the University of Florida's Institute of Food and Agricultural Sciences (IFAS) collaborate to lead the Innovation Lab for Livestock Systems, one of more than 20 Feed the Future Innovation Labs. The Bill & Melinda Gates Foundation and the United States Agency for International Development (USAID) both provided funding for the Innovation Lab for Livestock Systems. The Innovation Lab for Livestock Systems is operated by a management entity, which includes the area of inquiry team leaders and cross-cutting specialists at the University of Florida, regional coordinators headquartered in each target region or nation, and regional coordinators. The management entity collaborates with an external advisory board and an internal advisory committee at the University of Florida.

Nearly 50 projects with novel methods that address country-specific research objectives defined through collaboration with national stakeholders have received financing from the Innovation Lab for Livestock Systems. They also incorporate gender, human health, and nutrition components, as well as human and institutional capacity development (HICD). The Innovation Lab for Livestock Systems aims to use appropriate, advanced technologies, capacity development, and policies to sustainably improve livestock productivity, marketing, and animal-source food consumption to improve the diet, health, incomes, and livelihoods of vulnerable people. Other goals include enhancing the environmental sustainability of livestock systems, strengthening the resilience of vulnerable communities, and improving our understanding of how livestock systems evolve and affect food security, nutrition, and health. The three areas of inquiry include human health, food safety, diets & nutrition, production & disease management, and markets & innovation translation. During my time at Innovation Lab for Livestock Systems, I worked under the worthy mentorship of Dr. Sarah McKune and Dr. Arie Havelaar. Both serve Innovation Lab for Livestock Systems as co-leads of human health, food safety, diets & nutrition (1).

My portfolio products include a white paper and presentation on the inclusion of authors from lower-income and middle-income countries in the Innovation Lab for Livestock Systems funded research publications (2), a code sheet for continuous monitoring of author inclusion at Innovation Lab for Livestock Systems, and a research bibliography addressing interventions of

Water, Sanitation & Hygiene (WaSH) to improve nutrition outcomes in lower-income and middle-income countries.

Table 1.1 Summary of Portfolio Products

Portfolio Product		Description
1	SPSS Code Sheet	The coded data sheet for continuous monitoring of LMIC author inclusion at Innovation Lab for Livestock Systems addresses variables to determine descriptive statistics and bivariate analysis
2	White Paper and presentation on the results of LMIC author inclusion at Innovation Lab for Livestock Systems	The scientific paper was written on the LMIC author's inclusion in the publications of Innovation Lab for Livestock Systems and presented during the lab faculty meeting
3	Meeting summaries with PIs	Scheduling and posting interview notes on required assistance to principal investigators of current Innovation Lab for Livestock Systems projects addressing nutrition and food safety
4	WaSH and hygiene bibliography	A research bibliography addressing interventions of WaSH to improve nutrition outcomes in lower-income and middle-income countries to gather preliminary data from the last five years to write a grant to USAID on WaSH

Table 1.2 Portfolio Products and Competency Addressed

Portfolio Product		Number and Competency Addressed	
1	SPSS Code Sheet	2.	Select quantitative and qualitative data collection methods appropriate for a given public health context

		3.	Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming, and software, as appropriate
2	White Paper and presentation on the results of LMIC author inclusion at Innovation Lab for Livestock Systems	1.	Apply epidemiological methods to the breadth of settings and situations in public health practice
		3.	Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming, and software, as appropriate
		4.	Interpret results of data analysis for public health research, policy, or practice
		19	Communicate audience-appropriate public health content, both in writing and through oral presentation
3	Meeting summaries with PIs	13.	Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes
		16.	Apply principles of leadership, governance, and management, which include creating a vision, empowering others, fostering collaboration, and guiding decision making
4	WaSH and hygiene bibliography	2.	Select quantitative and qualitative data collection methods appropriate for a given public health context
		7	Assess population needs, assets, and capacities that affect communities' health

Chapter 2 - Competencies

Table 2.1 Summary of MPH Foundational Competencies

Number and Competency		Description
1.	Apply epidemiological methods to the breadth of settings and situations in public health practice	The assessment of data regarding Innovation Lab for Livestock Systems publications on their website enabled me to apply epidemiological methods to derive results for targeted variables.
2.	Select quantitative and qualitative data collection methods appropriate for a given public health context	I applied a quantitative data collection method to extract data from a primary source to identify the inclusion of authors in Innovation Lab for Livestock Systems publications and applied a qualitative data collection method to make a WaSH and hygiene bibliography to collect preliminary data for a grant submission to USAID on Animal WaSH.
3.	Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming, and software, as appropriate	I used Microsoft Excel, SPSS, and R program to code and analyze the data to identify descriptive statistics on author inclusivity and equity in Innovation Lab for Livestock Systems publications.
4.	Interpret results of data analysis for public health research, policy, or practice	The interpretation of data results was done mainly using descriptive statistics and bivariate analysis for LMIC author inclusion.
7.	Assess population needs, assets, and capacities that affect communities' health	The identification of interventions that access population needs and capacities in terms of hygiene, food safety, and nutrition in LMICs.
13.	Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes	The strengthening of partnerships through mid-project discussions with principal investigators to enhance public health intervention strategies and nutrition outcomes in African countries.
16.	Apply principles of leadership, governance, and management, which include creating a vision, empowering others, fostering collaboration, and guiding decision making	Communicating and conducting interview calls with principal investigators and discussing their hurdles to applying interventions in African countries and then following up with the assessment they required.
19.	Communicate audience-appropriate public health content, both in writing and through oral presentation	The presentation of the white paper in the form of a presentation at the Innovation Lab for Livestock Systems faculty meeting. The presentation was catered according to the audience.

Table 2.2 MPH Foundational Competencies Course Mapping

22 Public Health Foundational Competencies Course Mapping	MP H 701	MP H 720	MP H 754	MP H 802	MP H 818
Evidence-based Approaches to Public Health					
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	x		x		
2. Select quantitative and qualitative data collection methods appropriate for a given public health context	x	X	x		
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming, and software, as appropriate	x	X	x		
4. Interpret results of data analysis for public health research, policy, or practice	x		x		
Public Health and Health Care Systems					
5. Compare the organization, structure, and function of health care, public health, and regulatory systems across national and international settings		X			
6. Discuss how structural bias, social inequities, and racism undermine health and create challenges to achieving health equity at organizational, community, and societal levels					x
Planning and Management to Promote Health					
7. Assess population needs, assets, and capacities that affect communities' health		x		x	
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs					x
9. Design a population-based policy, program, project, or intervention			x		
10. Explain the basic principles and tools of budget and resource management		x	x		
11. Select methods to evaluate public health programs	x	x	x		
Policy in Public Health					
12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence		x	x	x	
13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes		x		x	x
14. Advocate for political, social, or economic policies and programs that will improve health in diverse populations		x			x
15. Evaluate policies for their impact on public health and health equity		x		x	
Leadership					
16. Apply principles of leadership, governance, and management, which include creating a vision, empowering others, fostering collaboration, and guiding decision making		x			x
17. Apply negotiation and mediation skills to address organizational or community challenges		x			

Communication					
18. Select communication strategies for different audiences and sectors	DMP 815, FNDH 880 or KIN 796				
19. Communicate audience-appropriate public health content, both in writing and through oral presentation	DMP 815, FNDH 880 or KIN 796				
20. Describe the importance of cultural competence in communicating public health content		x			x
Interprofessional Practice					
21. Perform effectively on interprofessional teams		x			x
Systems Thinking					
22. Apply systems thinking tools to a public health issue			x	x	

Table 2.3 Application of Systems Thinking Tools to a Public Health Issue

Use of Systems Thinking Tools	
Systems Thinking Tool	Description of Use
Innovation (or change management) history	Innovation History generates knowledge about a system by compiling a systematic history of key events, intended and unintended outcomes, and measures taken to address emergent issues. It involves in-depth interviews with key stakeholders to build an understanding of the performance of the system from several different viewpoints. The in-depth interviews with six principal investigators of ongoing projects of Innovation Lab for Livestock Systems to build an understanding of the performance of the system from several different viewpoints and to extend support to improve nutrition and food safety outcomes.
Systems archetypes	Systems Archetypes are several generic structures that describe common behaviors between the parts of a system. They provide templates to demonstrate different types of balancing and reinforcing feedback loops, which can be used by teams to come to a diagnosis about how a system is working, and how performance changes over time. The generation of code sheets to continue monitoring the in-country author's inclusion at the Innovation Lab for Livestock Systems and

	getting feedback to improve the inclusion of authors from LMICs in the publication manuscripts.
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References

1. Feed the Future Innovation Lab for Livestock Systems. Areas of Inquiry. 2023.
<https://livestocklab.ifas.ufl.edu/themes/>
2. Feed the Future Innovation Lab for Livestock Systems. Articles in Journals. 2023.
<https://livestocklab.ifas.ufl.edu/resources/articles-in-journals/>

Appendix A - White Paper



Feed the Future
Innovation Lab for Livestock Systems

Assessment of In-Country Author Inclusion in the Publications of Feed the Future **Innovation Lab for Livestock Systems**

The Innovation Lab for Livestock Systems at Feed the Future develops long-term research and capacity-building initiatives, through multidisciplinary, integrated, and competitively financed applied research. This synthesis aims to analyze the authorship and inclusion of low- and middle-income country (LMIC) partners in publications that have come from Innovation Lab for Livestock Systems funded research. The LMIC partners include Burkina Faso, Niger, Nigeria, Ethiopia, Rwanda, Nepal, Cambodia, Kenya, and Uganda. Focusing on these countries, Innovation Lab for Livestock Systems explores three areas of inquiry (AOI); Markets and Innovation Translation, Production and Disease Management, and Human Health, Food Safety, Diets & Nutrition in its research. Innovation Lab for Livestock Systems has generated 127 peer-reviewed journal articles as of April 10th, 2023. The enrichment of scientific knowledge through a variety of perspectives and experiences is one of the major advantages of having lower and middle-income researchers write for journals. Researchers from various socioeconomic strata provide original approaches, insights, and contextual knowledge to the research process. Their participation can aid in enlarging the study field, improving the reliability of the results, and advancing the relevance and usefulness of scientific developments in many contexts.

Materials & Methods:

The data of published work was assessed through the Innovation Lab for Livestock Systems website and then it was extracted into sheets. To generate the analysis of the Innovation Lab for Livestock Systems publications the data was coded into Excel sheets and SPSS 2022 to calculate accurate percentages. The data was extracted for the first author, affiliation country of the first author, in-country partners, non-LMIC and LMIC country partners, country of research, area of inquiry, access status, and Doi. The country affiliation and country of research were coded on SPSS and details of codes are provided in a separate code book.

Results:

Most of the primary research papers are based on research conducted in the partner countries and the review papers are based on comparison across lower and middle-income countries (LMIC) and developed countries. The details of the research countries are shown in Figure 1.

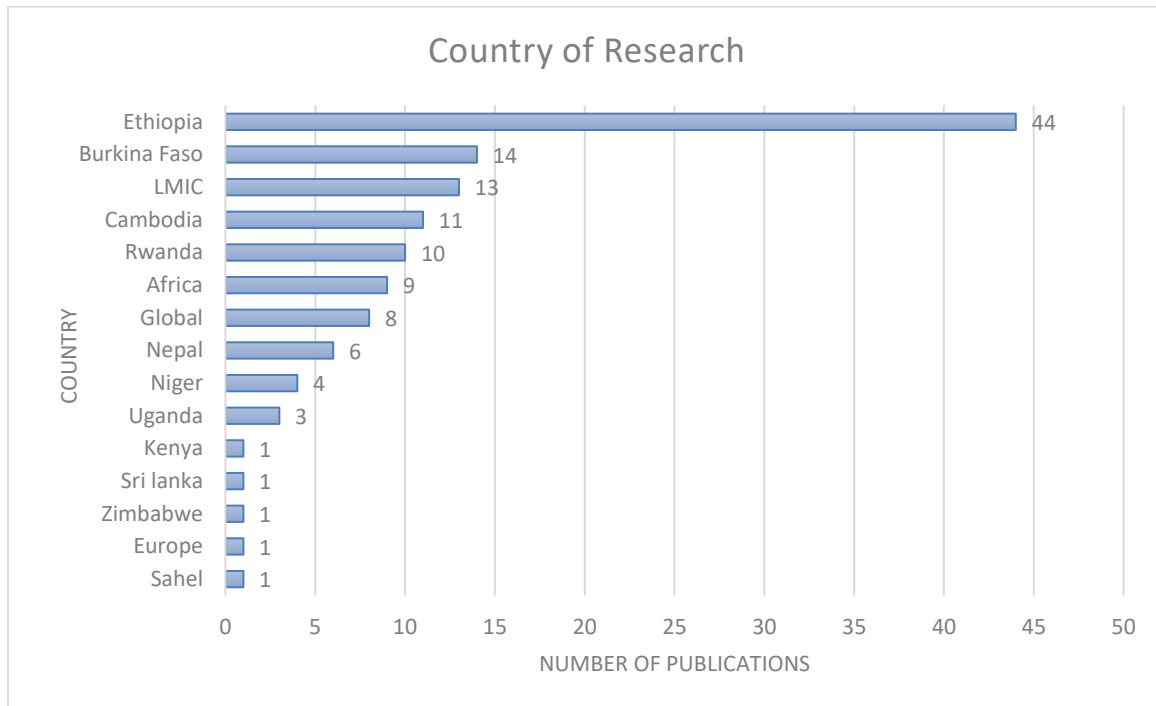


Figure 1. The country of research in the publications

Area of Inquiry

The investigation of AOIs across this published literature shows that the primary focus of 60.6% of articles is Production & Disease Management (PDM), 31.5% inspect Human Health, Food Safety, Diets & Nutrition (HFDN), and 7.9% examine Markets and Innovation Translation (MIT). The details are in Figure 2.

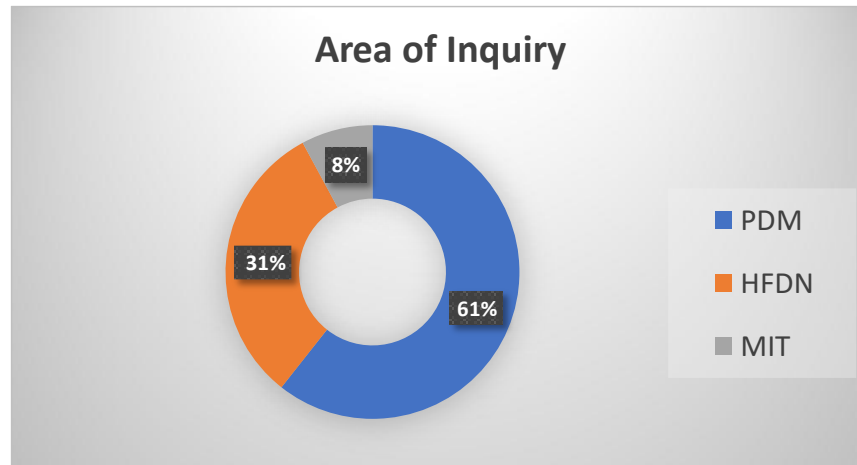


Figure 2. Area of Inquiry of Publications

1. Number and percentage of publications that include in-country researchers.

The total number of analyzed publications is 127. The publications that have authors (first author or co-author) from LMIC partner countries are 91 (71.1%). Most in-country researchers are from Ethiopia (35/127, 27.5%). The AOI division of the 91 papers with in-country partner authors is 65 (71.42%) PDM, 20 (21.9%) HHFDN, and 6 (6.5%) MIT research papers.

2. Number and percentage of publications that have in-country researchers as the first author.

The number of publications with researchers from LMIC partner countries (in-country) as first authors is 55 out of 127 (43.3%). Considering only the partner countries, the country (number, percentage) affiliation of these first authors is Ethiopia (30, 54.5%), Burkina Faso (8, 14.5%), Niger (6, 10.9%), Cambodia (6, 10.9%), Nepal (3, 5.4%), Kenya (2, 3.6%), and Uganda (1, 1.8%). Among these publications 47 (85.45%) focus on PDM, 5 (9%) examine HHFDN, and 4 (7.2%) investigate MIT areas of inquiry. Most of these PDM AOI publications have first authors affiliated with Ethiopia (26, 47.27%).

Sr. No	First Author Affiliation	Number	Percentage
1	Ethiopia	30	23.6
2	Burkina Faso	8	6.3
3	Niger	6	4.7
4	Cambodia	6	4.7
5	Nepal	3	2.4
6	Kenya	3	1.6
7	Uganda	1	0.8

8	USA	61	48.0
9	Sweden	5	3.9
10	UK	3	2.4
11	Belgium	2	1.6
	Total	127	100.0

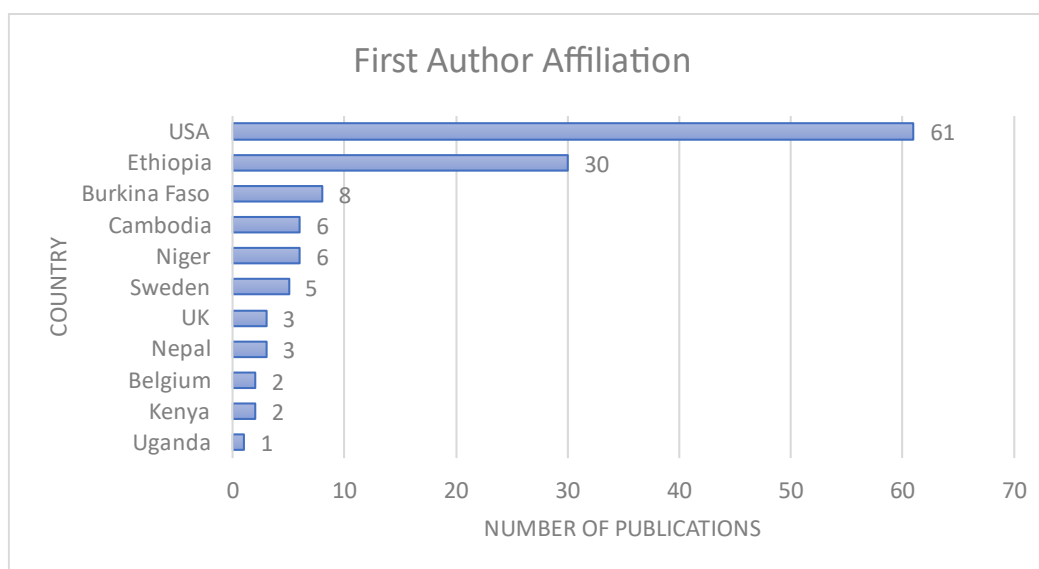


Figure 3. Affiliation countries of first authors of Publications

3. Number and percent of publications that have authors from LMIC but who are not considered “in-country” partners (they may be based at a US institution or otherwise).

The number of publications that have researchers from LMIC countries but who are not considered Innovation Lab for Livestock Systems in-country partners is 17 (13.3%). It includes India (5), Sri Lanka (1), Botswana (1), Mali (1), Myanmar (2), Egypt (1), Vietnam (2), Togo (1), Zambia (1), Tanzania (1), and Colombia (1).

4. Number and percent of publications that have first authors from LMIC but who are not “in-country” partners.

There are no publications that have first authors from LMIC, who are not “in-country” partners. Although 61 publications have United States-based first authors, 5 Swedish, 3 European, and 2 first authors are from Belgium.

5. Access Status

There are 97 (76.4) open-access articles published in peer-reviewed journals while 30 (23.6%) are not open-access articles.

Discussion:

Researchers from high-income nations produce over 80% of the world's scientific publications, while those from low-income nations produce only about 1%, according to a report released by the Global Research Council in 2016 (Global Research Council, 2016). This discrepancy shows that there is a considerable divide in the representation and participation of scientists from low- and middle-income nations. Additionally, Saldaa-Zorrilla et al. (2020) examined the patterns of authorship in scientific publications across a range of disciplines. In particular, high-impact journals tend to favor authors from high-income nations, according to the study. The authors emphasized the necessity of addressing this disparity and advocating for more fair authorship procedures.

A survey done by Wagner et al. (2020) identified certain significant obstacles to lower- and middle-income researchers' inclusion in scientific publications. The survey participants, who were mainly from low- and middle-income countries, listed financial access restrictions, a lack of infrastructure for doing research, and insufficient mentorship opportunities as major obstacles. These elements play a part in the underrepresentation of researchers from low- and middle-income nations as authors in high-income nation publications. Numerous proposals and activities have been put into place to remedy these inequities. The Open Research Scholarships program, for instance, was started by the African Academy of Sciences to increase the visibility and capacity of African early-career researchers by funding the publication of their work in international journals (African Academy of Sciences, n.d.). Similar to this, the International Network for Government Science Advice (INGSA, n.d.) has promoted greater collaboration and diversity in scientific publishing through programs including mentorship programs and joint research projects.

Programs for mentoring and capacity building can be designed to aid and direct researchers from lower- and middle-income nations. These courses may concentrate on improving research methodology, mastering the publication process, and honing scientific writing abilities. Researchers can contribute more successfully as authors in publications from high-income nations if they are given the required resources and training. Additionally, efforts should be made to improve accessibility and lessen linguistic hurdles. This may entail offering translation services, promoting the use of plain language in scientific writing, and enhancing the accessibility of research articles through open-access programs. Such actions can encourage greater inclusivity in academic publishing and enable academics from many backgrounds to actively participate in the scientific debate.

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Appendix B - Meeting Summaries

Overview of Ongoing Innovation Lab for Livestock Systems Projects & PI Meeting Summaries

PI First Name	Email (PI)	Country	Type	Project Title	Status on 2/16/2023	Lead Institution
Clarisse	c.umutoni@cgiar.org	Niger	Reach	Enhancing the Productivity and Resilience of Agro-Pastoral Systems, and Income, Food and Nutrition Security Through Market-Oriented Innovations	ongoing	International Crops Research Institute for the Semi-Arid Tropics
Andrew	a.stringer@liverpool.ac.uk	Ethiopia	Focus	Improving Smallholder Poultry Production and Egg Consumption in Children Under Two in Ethiopia	ongoing	University of Liverpool, UK
Bhola Shankar	bhola.shrestha@heifer.org	Nepal	Reach	Integrated Approach to Enhance Milk Quality, Dairy Animal Productivity, and Milk Consumption by Vulnerable Household Members in Rural Nepal	close to starting	Heifer Project International
Michel	M.Dione@cgiar.org	Burkina Faso	Reach	Poultry Losses and One Health (POLOH): Reducing losses and zoonotic risks along the poultry value chain through a One Health approach	ongoing	International Livestock Research Institute
Felicia	fwu@msu.edu	Ethiopia	Reach	Aflatoxin M1 Health Risks vs. Benefits of Dairy Consumption in Ethiopian Children: An Epidemiological Trial and Risk-Benefit Analysis	ongoing	Michigan State University
Moussa	moussa_zongo59@yahoo.fr	Burkina Faso	Focus	Improvement of Traditional Techniques for Making Biltong and Kitoza by Applying Solar Dryers in Centre-Nord of Burkina Faso	pending	Université Ouaga I professeur Joseph KI-ZERBO



FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

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Name	Project Title & Location	Required Assistance/Follow-up
Michel Dion (PI) Claudia Ganser (Co-PI)	POULTRY LOSSES AND ONE HEALTH (POLOH): Reducing losses and zoonotic risks along the poultry value chain through a One Health approach Burkina Faso, Centre Nord	1. Claudia/Michel will share the survey to solicit feedback from Drs. McKune & Havelaar on indicators of diarrhea, proximity to animals, and nutrition 2. Michel Dion will follow up with Dr. McKune if he wants access to IDRC-developed Gender and Intersectionality Transformative Approaches to improved poultry production or the Un Oeuf flipbook 3. Dr. Havelaar will connect Michel Dion with Roy Curtis at the Vet school at UF 4. Claudia/Micheal will share lab protocols 5. Dr. McKune will share the CAGED survey
Felicia Wu (PI)	Aflatoxin M1 Health Risks vs. Benefits of Dairy Consumption in Ethiopian Children: An Epidemiological Trial and Risk-Benefit Analysis Ethiopia; Region Southern Nations, Nationalities, and Peoples (SNNP) (Zones Gurage and Hadiya)	1. Dr. Wu will check survey validation with the team considering the fasting practices of the target population. 2. Dr. Wu will follow up with Dr. McKune regarding gender analysis outcomes - if gender differences exist, we can consider a follow-up qualitative study 3. Dr. Wu can connect with Mulu to further discuss her project 4. Dr. McKune will share the WEAI R code
Andrew Stringer (PI) (Andy)	Improving smallholder poultry production and egg consumption in children under two in Ethiopia Ethiopia, Misrak Shewa Zone	1. Dr. Stringer looks to learn from the CAGED project and assessment of animal ownership-associated risks and safety. 2. In data collection, Dr. Stringer is recommended to consider hand sanitation before eating, handling food, and feeding a child. 3. Further discussion at IP meeting with Dr. Arie in May 2023
Bhola Shankar Shrestha (PI)	Integrated approach to enhance milk quality, dairy animal productivity and milk consumption by vulnerable household members in rural Nepal Rural Nepal	1. Project needs support to enhance effective data collection for objectives 2 and 3 2. Follow-up meeting in the presence of Dr. Havelaar, Dr. De Vries, and Dr. Laurie Miller would be helpful to identify missing pieces and fulfilling the objective of this meeting. 3. Mr. Shrestha is responsible for objective 1 and it does not require any assistance for now.



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Clarisse Umutoni (PI)	Enhancing the productivity and resilience of agro-pastoral systems, and income, food and nutrition security through market-oriented innovations in Niger Niger	1. Ms. Umutoni would appreciate guidance to address household nutrition, partner influence on animal-sourced food consumption, and barriers to the consumption of animal-sourced foods. 2. Ms. Umutoni is requested to share the baseline and multi-dimensional poverty piece of the survey (baseline survey and overview of student-led nutrition study) 3. Ms. Umutoni would like to explore the nutritional quality of the targeted food products of the project and needs financial assistance for this. Thus, recommended to continue reflecting on any possibility of improving the human health/nutritional impact of the overall study, including small side projects such as those supporting student research. 4. Dr. McKune will share MINERVA materials currently in development to evaluate resilience in the target population of Niger (Zinder) 5. Dr. McKune will follow-up on how much financial assistance can be provided under her AOI (Discuss possible support to the Niger REACH project to evaluate the nutritional value of ASF products with Saskia, Geoff, and Arie)
Zongo Moussa (PI)	-	<i>Mr. Moussa was unable to connect at the designated meeting time and the proposal is still being developed. Dr. McKune emailed to have a meeting rescheduled, but we didn't hear back from him.</i>

Appendix C - WaSH Bibliography

WaSH Bibliography

Chard AN, Garn JV, Chang HH, Clasen T, Freeman MC. Impact of a school-based water, sanitation, and hygiene intervention on school absence, diarrhea, respiratory infection, and soil-transmitted helminths: results from the WASH HELPS cluster-randomized trial. J Glob Health. 2019 Dec;9(2):020402. doi 10.7189/jogh.09.020402. PMID: 31360445; PMCID: PMC6657003.

The intervention targeted primary schools and involved the provision of improved water, sanitation, and hygiene facilities and practices. The researchers evaluated the impact of the intervention on school absence, diarrhea, respiratory infection, and soil-transmitted helminth (STH) infections. The study collected data from 65 primary schools in Nyanza Province, Kenya. The findings of the study indicated that the WASH intervention had a significant positive effect on reducing school absences. The intervention was associated with a 25% reduction in student absenteeism. However, the study did not find significant reductions in the prevalence of diarrhea, respiratory infection, or STH infections. The authors concluded that the school-based WASH intervention positively impacted reducing school absenteeism, but its effects on other health outcomes were limited. They suggested that additional strategies, such as health education and improved access to healthcare, may be necessary to address the other health challenges faced by schoolchildren.

Budge S, Hutchings P, Parker A, Tyrrel S, Norton S, Garbutt C, Woldemedhin F, Jemal MY, Moges M, Hussen S, Beyene H. A randomised controlled feasibility trial of a BabyWASH household playspace: The CAMPI study. PLoS Negl Trop Dis. 2021 Jul 14;15(7):e0009514. doi: 10.1371/journal.pntd.0009514. PMID: 34260591; PMCID: PMC8312948.

The intervention involved the implementation of a specially designed playspace within households, which aimed to provide a clean and safe environment for infants to play while incorporating WASH elements. The researchers evaluated the feasibility and acceptability of the playspace intervention among participating households. The findings of the study suggested that the BabyWASH household playspace intervention was feasible and well-received by the households. The intervention showed potential for improving WASH conditions for infants, as it facilitated handwashing, improved waste management, and created a hygienic play area. However, the study did not assess the direct impact of the intervention on health outcomes. The authors concluded that the BabyWASH household playspace intervention holds promise as a

means to improve WASH conditions for infants within the household setting. They emphasized the need for further research to explore the potential health benefits associated with such interventions and to evaluate their long-term effectiveness.

Contreras JD, Islam M, Mertens A, Pickering AJ, Kwong LH, Arnold BF, Benjamin-Chung J, Hubbard AE, Alam M, Sen D, Islam S, Rahman M, Unicomb L, Luby SP, Colford JM, Ercumen A. Longitudinal Effects of a Sanitation Intervention on Environmental Fecal Contamination in a Cluster-Randomized Controlled Trial in Rural Bangladesh. Environ Sci Technol. 2021 Jun 15;55(12):8169-8179. doi: 10.1021/acs.est.1c01114. Epub 2021 Jun 4. PMID: 34086447; PMCID: PMC8213058.

The intervention focused on improving sanitation facilities and promoting hygienic behaviors in households. The researchers conducted longitudinal sampling of environmental sources, such as soil and water, to measure fecal contamination. They compared the levels of fecal contamination in intervention and control clusters over time. The results of the study indicated that the sanitation intervention led to a significant reduction in environmental fecal contamination. The intervention clusters showed lower levels of fecal contamination in soil and water compared to the control clusters. The reduction in fecal contamination persisted throughout the study period, suggesting the sustainability of the intervention's impact. The authors concluded that the sanitation intervention had a positive and lasting effect on reducing environmental fecal contamination in rural Bangladesh. They emphasized the importance of improving sanitation infrastructure and promoting hygienic practices to mitigate fecal contamination and reduce the risk of waterborne diseases.

Fuhrmeister ER, Ercumen A, Pickering AJ, Jeanis KM, Crider Y, Ahmed M, Brown S, Alam M, Sen D, Islam S, Kabir MH, Islam M, Rahman M, Kwong LH, Arnold BF, Luby SP, Colford JM Jr, Nelson KL. Effect of Sanitation Improvements on Pathogens and Microbial Source Tracking Markers in the Rural Bangladeshi Household Environment. Environ Sci Technol. 2020 Apr 7;54(7):4316-4326. doi: 10.1021/acs.est.9b04835. Epub 2020 Mar 26. PMID: 32167305; PMCID: PMC7144219.

The researchers conducted a randomized controlled trial where households were provided with improved sanitation facilities and hygiene education. They collected samples from various environmental sources within the households, such as water, soil, and surfaces, to measure the presence of pathogens and microbial markers indicating fecal contamination. The results of the study demonstrated that the sanitation improvements led to a significant reduction in fecal contamination indicators in the household environment. The intervention households showed lower levels of pathogens and microbial markers compared to the control households. This

suggests that sanitation interventions effectively reduced the transmission of fecal pathogens within the household setting. The authors concluded that implementing sanitation improvements and promoting good hygiene practices can have a positive impact on reducing fecal contamination and improving the overall household environment. The findings highlight the importance of sanitation interventions in preventing waterborne diseases and improving public health outcomes, particularly in rural settings.

Parvez SM, Azad R, Pickering AJ, Kwong LH, Arnold BF, Rahman MJ, Rahman MZ, Alam M, Sen D, Islam S, Rahman M, Colford JM Jr, Luby SP, Unicomb L, Ercumen A.

Microbiological contamination of young children's hands in rural Bangladesh:

Associations with child age and observed hand cleanliness as proxy. PLoS One. 2019 Sep 10;14(9):e0222355. doi: 10.1371/journal.pone.0222355. PMID: 31504064; PMCID: PMC6736272.

The study aimed to understand the hygiene practices and factors influencing hand contamination among young children in this setting. The researchers collected hand swab samples from children in rural households and assessed the levels of microbiological contamination. They also observed the cleanliness of children's hands as a proxy measure of hand hygiene practices. The study analyzed the associations between child age, observed hand cleanliness, and hand contamination levels. The findings of the study revealed that the hands of young children in rural Bangladesh were frequently contaminated with microorganisms. The contamination levels were higher among younger children compared to older ones. Additionally, the study found a significant correlation between observed hand cleanliness and hand contamination levels, indicating that better hand hygiene practices were associated with lower microbial contamination. The authors concluded that there is a need to improve hand hygiene practices among young children in rural Bangladesh to reduce the risk of infections and improve health outcomes. They emphasized the importance of promoting proper handwashing techniques and hygiene education among caregivers and children to prevent the transmission of pathogens.

Kwong LH, Sen D, Islam S, Shahriar S, Benjamin-Chung J, Arnold BF, Hubbard A, Parvez SM, Islam M, Unicomb L, Rahman MM, Nelson K, Colford JM Jr, Luby SP, Ercumen A.

Effect of sanitation improvements on soil-transmitted helminth eggs in courtyard soil from rural Bangladesh: Evidence from a cluster-randomized controlled trial. PLoS Negl Trop Dis. 2021 Jul 28;15(7):e0008815. doi: 10.1371/journal.pntd.0008815. PMID: 34319986; PMCID: PMC8351931.

The researchers collected soil samples from courtyards in rural households and examined them for the presence of STH eggs. The study compared the levels of STH contamination between households that received sanitation improvements and those that did not. The findings of the study indicated that the sanitation improvements led to a significant reduction in STH egg contamination in courtyard soil. The households that received the sanitation interventions had lower levels of STH eggs compared to the control households. This suggests that the sanitation improvements effectively reduced the environmental transmission of STH infections. The authors concluded that implementing sanitation improvements can be an effective strategy to reduce STH contamination in the household environment. The findings highlight the importance of adequate sanitation infrastructure and practices in preventing the transmission of STH infections in rural settings.

Steinbaum L, Mboya J, Mahoney R, Njenga SM, Null C, Pickering AJ. Effect of a sanitation intervention on soil-transmitted helminth prevalence and concentration in household soil: A cluster-randomized controlled trial and risk factor analysis. PLoS Negl Trop Dis. 2019 Feb 11;13(2):e0007180. doi: 10.1371/journal.pntd.0007180. PMID: 30742614; PMCID: PMC6386409.

The intervention involved the implementation of improved sanitation facilities and practices in households. The researchers collected soil samples from households and assessed the prevalence and concentration of STH in the soil. They also examined various risk factors, such as household sanitation conditions and sociodemographic factors, to understand their association with STH contamination. The results of the study revealed that the sanitation intervention led to a significant reduction in both the prevalence and concentration of STH in household soil. The intervention households had lower levels of STH contamination compared to the control households. Additionally, the risk factor analysis identified certain factors, such as the presence of open defecation areas and the number of household members, as associated with increased STH contamination. The authors concluded that implementing sanitation interventions can effectively reduce STH contamination in household soil. The findings underscore the importance of improved sanitation practices and infrastructure in preventing the transmission of STH infections. The study also highlights the significance of addressing risk factors and promoting behavior change to sustain the benefits of sanitation interventions.

Ercumen A, Benjamin-Chung J, Arnold BF, Lin A, Hubbard AE, Stewart C, Rahman Z, Parvez SM, Unicomb L, Rahman M, Haque R, Colford JM Jr, Luby SP. Effects of water, sanitation, handwashing and nutritional interventions on soil-transmitted helminth infections in young children: A cluster-randomized controlled trial in rural Bangladesh.

PLoS Negl Trop Dis. 2019 May 3;13(5):e0007323. doi: 10.1371/journal.pntd.0007323. PMID: 31050672; PMCID: PMC6519840.

The interventions focused on improving water and sanitation infrastructure, promoting handwashing practices, and providing nutritional supplements to young children. The researchers assessed the impact of these interventions on the prevalence and intensity of STH infections among children. The findings of the study indicated that the combined interventions led to a significant reduction in both the prevalence and intensity of STH infections in young children. The interventions resulted in a 50% reduction in the overall prevalence of STH infections and a substantial decrease in the number of STH eggs in the children's stool samples. The handwashing intervention, in particular, showed a significant impact on reducing STH infections. The authors concluded that a comprehensive approach that includes water, sanitation, handwashing, and nutritional interventions can effectively reduce the burden of STH infections in young children. The study highlights the importance of addressing multiple risk factors and implementing integrated interventions to combat STH infections and improve child health outcomes.

Contreras JD, Islam M, Mertens A, Pickering AJ, Arnold BF, Benjamin-Chung J, Hubbard AE, Rahman M, Unicomb L, Luby SP, Colford JM Jr, Ercumen A. Evaluation of an on-site sanitation intervention against childhood diarrhea and acute respiratory infection 1 to 3.5 years after implementation: Extended follow-up of a cluster-randomized controlled trial in rural Bangladesh. PLoS Med. 2022 Aug 8;19(8):e1004041. doi: 10.1371/journal.pmed.1004041. PMID: 35939520; PMCID: PMC9394830.

The intervention involved the implementation of on-site sanitation facilities in rural households. The researchers conducted an extended follow-up 1 to 3.5 years after the implementation of the intervention to assess its sustained impact. They collected data on diarrhea and ARI episodes in children and compared the outcomes between intervention and control clusters. The findings of the study revealed that the on-site sanitation intervention led to a significant reduction in childhood diarrhea episodes even after 1 to 3.5 years of implementation. However, there was no significant effect observed on ARI episodes during the extended follow-up period. The authors concluded that the on-site sanitation intervention had a sustained impact in reducing childhood diarrhea in rural Bangladesh. The findings highlight the importance of improved sanitation infrastructure in preventing diarrheal diseases. However, the lack of significant impact on ARI episodes suggests that additional interventions or approaches may be needed to address respiratory infections in this context.

Holcomb DA, Knee J, Sumner T, Adriano Z, de Bruijn E, Nalá R, Cumming O, Brown J, Stewart JR. Human fecal contamination of water, soil, and surfaces in households sharing poor-quality sanitation facilities in Maputo, Mozambique. Int J Hyg Environ Health. 2020 May;226:113496. doi: 10.1016/j.ijheh.2020.113496. Epub 2020 Mar 2. PMID: 32135507; PMCID: PMC7174141.

The researchers collected samples from water sources, soil, and various surfaces within households and analyzed them for the presence of human fecal contamination indicators. The study focused on households that relied on shared sanitation facilities with substandard conditions. The findings of the study revealed widespread human fecal contamination in water, soil, and surfaces within the households. The samples showed high levels of fecal contamination indicators, indicating poor sanitation practices and the potential for disease transmission. The study highlights the need for improved sanitation infrastructure and behavior change interventions to mitigate the risks associated with fecal contamination. The authors emphasize the importance of access to safe and improved sanitation facilities to protect public health and prevent the transmission of waterborne diseases. The findings underscore the urgency of addressing sanitation challenges in Maputo and similar settings to improve living conditions and reduce the burden of fecal contamination-related illnesses.

Sangalang SO, Lemence ALG, Ottong ZJ, Valencia JC, Olaguera M, Canja RJF, Mariano SMF, Prado NO, Ocaña RMZ, Singson PAA, Cumagun ML, Liao J, Anglo MVJC, Borgemeister C, Kistemann T. School water, sanitation, and hygiene (WaSH) intervention to improve malnutrition, dehydration, health literacy, and handwashing: a cluster-randomised controlled trial in Metro Manila, Philippines. BMC Public Health. 2022 Nov 7;22(1):2034. doi: 10.1186/s12889-022-14398-w. PMID: 36344973; PMCID: PMC9641834.

The intervention focused on improving access to safe water, and sanitation facilities, and promoting hygiene practices in schools. The researchers conducted a cluster-randomized trial where participating schools were assigned to either the intervention group or the control group. They measured outcomes related to malnutrition, dehydration, health literacy, and handwashing behaviors. The results of the study indicated that the WaSH intervention had a positive impact on the measured outcomes. The intervention group showed improvements in malnutrition rates, hydration levels, health literacy, and handwashing behaviors compared to the control group. The findings suggest that the implementation of the WaSH intervention in schools can contribute to improved health outcomes and hygiene practices among students. The authors conclude that school-based WaSH interventions have the potential to address health challenges related to malnutrition, dehydration, and hygiene practices among schoolchildren. The study

highlights the importance of promoting access to safe water, sanitation, and hygiene facilities in educational settings to enhance overall health and well-being.

Aragie S, Tadesse W, Dagneu A, Hailu D, Dubie M, Wittberg DM, Melo JS, Haile M, Zeru T, Freeman MC, Nash SD, Callahan EK, Tadesse Z, Arnold BF, Porco TC, Lietman TM, Keenan JD. Changing hygiene behaviours: a cluster-randomized trial, Ethiopia. Bull World Health Organ. 2021 Nov 1;99(11):762-772A. doi: 10.2471/BLT.21.285915. Epub 2021 Aug 30. PMID: 34737469; PMCID: PMC8542271.

The intervention involved a behavior change communication approach that aimed to educate and encourage households to adopt hygienic behaviors such as handwashing with soap, safe disposal of feces, and safe water management. The researchers conducted a cluster-randomized trial, with participating households assigned to either the intervention group or the control group. The findings of the study revealed that the hygiene behavior intervention led to significant improvements in the adoption of targeted behaviors among households in the intervention group. The households showed increased adherence to handwashing with soap, safe disposal of feces, and safe water management practices compared to the control group. The authors concluded that the behavior change communication intervention was effective in promoting and sustaining improved hygiene behaviors in rural Ethiopian households. The study highlights the importance of education and behavior change approaches in driving positive hygiene practices, which can contribute to improved public health outcomes.

Aragie S, Wittberg DM, Tadesse W, Dagneu A, Hailu D, Chernet A, Melo JS, Aiemyoy K, Haile M, Zeru T, Tadesse Z, Gwyn S, Martin DL, Arnold BF, Freeman MC, Nash SD, Callahan EK, Porco TC, Lietman TM, Keenan JD. Water, sanitation, and hygiene for control of trachoma in Ethiopia (WUHA): a two-arm, parallel-group, cluster-randomised trial. Lancet Glob Health. 2022 Jan;10(1):e87-e95. doi: 10.1016/S2214-109X(21)00409-5. PMID: 34919861; PMCID: PMC9360557.

The trial involved two groups: an intervention group that received WASH interventions targeting improved access to clean water, sanitation facilities, and hygiene promotion, and a control group that received standard trachoma control measures. The researchers assessed the prevalence of trachoma in both groups to evaluate the impact of the WASH interventions. The findings of the study demonstrated that the WASH interventions led to a significant reduction in the prevalence of trachoma in the intervention group compared to the control group. The prevalence of trachoma decreased by 70% in the intervention group, indicating the effectiveness of the WASH interventions in controlling the disease. The authors concluded that implementing WASH interventions, including improved access to clean water, sanitation

facilities, and hygiene promotion, is essential for trachoma control in Ethiopia. The study highlights the importance of addressing environmental factors and improving hygiene practices to prevent and reduce the burden of trachoma.

Gladstone MJ, Chandna J, Kandawasvika G, Ntozini R, Majo FD, Tavengwa NV, Mbuya MNN, Mangwadu GT, Chigumira A, Chasokela CM, Moulton LH, Stoltzfus RJ, Humphrey JH, Prendergast AJ; SHINE Trial Team. Independent and combined effects of improved water, sanitation, and hygiene (WASH) and improved complementary feeding on early neurodevelopment among children born to HIV-negative mothers in rural Zimbabwe: Substudy of a cluster-randomized trial. PLoS Med. 2019 Mar 21;16(3):e1002766. doi: 10.1371/journal.pmed.1002766. PMID: 30897095; PMCID: PMC6428259.

The trial involved interventions targeting WASH practices and complementary feeding. The researchers assessed the neurodevelopment of children using a standardized tool and compared the outcomes between the intervention and control groups. The findings of the substudy indicated that both the WASH intervention and improved complementary feeding had positive effects on early neurodevelopment in children. The children in the intervention groups showed better cognitive, language, and motor development compared to those in the control groups. The study also observed that the combined effect of the WASH and complementary feeding interventions was greater than the individual effects of each intervention alone.

The authors concluded that both improved WASH practices and improved complementary feeding contribute to better early neurodevelopment in children. The study highlights the importance of integrating these interventions to maximize the benefits for child development, particularly in resource-limited settings.

Delea MG, Snyder JS, Woreta M, Zewudie K, Solomon AW, Freeman MC. Development and reliability of a quantitative personal hygiene assessment tool. Int J Hyg Environ Health. 2020 Jun;227:113521. doi: 10.1016/j.ijheh.2020.113521. Epub 2020 Apr 8. PMID: 32278303; PMCID: PMC7116344.

The researchers developed the quantitative assessment tool based on established guidelines and literature on personal hygiene. The tool included various indicators and measures related to hygiene practices such as handwashing, face washing, and oral hygiene. The tool was then tested for its reliability by assessing its consistency and reproducibility through repeated measurements. The findings of the study demonstrated that the developed quantitative personal hygiene assessment tool exhibited good reliability. The tool showed consistent results across repeated measurements, indicating its ability to reliably assess personal hygiene practices. The tool can provide a standardized approach for evaluating personal hygiene behaviors and their

potential health impacts. The authors concluded that the quantitative personal hygiene assessment tool can be a valuable resource for researchers and practitioners working in the field of hygiene promotion and public health. It can aid in the evaluation of hygiene interventions, monitoring progress, and informing evidence-based strategies for improving personal hygiene practices.

Wandera EA, Muriithi B, Kathiiko C, Mutunga F, Wachira M, Mumo M, Mwangi A, Tinkoi J, Meiguran M, Akumu P, Ndege V, Kasiku F, Ang'awa J, Mochizuki R, Kaneko S, Morita K, Ouma C, Ichinose Y. Impact of integrated water, sanitation, hygiene, health and nutritional interventions on diarrhoea disease epidemiology and microbial quality of water in a resource-constrained setting in Kenya: A controlled intervention study. Trop Med Int Health. 2022 Aug;27(8):669-677. doi: 10.1111/tmi.13793. Epub 2022 Jun 30. Erratum in: Trop Med Int Health. 2022 Aug 25;: PMID: 35700209; PMCID: PMC9541685.

The study implemented a comprehensive intervention that included improvements in water sources, sanitation facilities, hygiene practices, health education, and nutritional interventions. The researchers compared the outcomes between the intervention group, which received the integrated interventions, and the control group. The findings of the study demonstrated that the integrated interventions had a positive impact on reducing diarrheal disease epidemiology. The intervention group experienced a lower incidence and prevalence of diarrhea compared to the control group. Additionally, the microbial quality of water improved in the intervention group, suggesting a reduction in waterborne pathogens. The authors concluded that the integrated interventions targeting water, sanitation, hygiene, health, and nutrition can effectively reduce the burden of diarrheal diseases and improve the microbial quality of water in resource-constrained settings. The study highlights the importance of implementing comprehensive approaches to address multiple risk factors and promote better health outcomes.

Chandna J, Ntozini R, Evans C, Kandawasvika G, Chasekwa B, Majo F, Mutasa K, Tavengwa N, Mutasa B, Mbuya M, Moulton LH, Humphrey JH, Prendergast A, Gladstone M. Effects of improved complementary feeding and improved water, sanitation and hygiene on early child development among HIV-exposed children: substudy of a cluster randomised trial in rural Zimbabwe. BMJ Glob Health. 2020 Jan 13;5(1):e001718. doi: 10.1136/bmjgh-2019-001718. PMID: 32133164; PMCID: PMC7042608.

The trial involved interventions targeting complementary feeding and WASH practices. The researchers assessed early child development outcomes using standardized tools and compared the outcomes between the intervention and control groups. The findings of the substudy indicated that both improved complementary feeding and improved WASH practices

had positive effects on early child development among HIV-exposed children. The intervention groups showed improved cognitive, motor, and language development compared to the control groups. The study also observed that the combined effect of improved complementary feeding and improved WASH practices had a greater impact on early child development than each intervention alone. The authors concluded that integrating interventions targeting complementary feeding and WASH practices can significantly improve early child development among HIV-exposed children. The study highlights the importance of addressing multiple factors that influence child development, including nutrition and hygiene practices, to maximize positive outcomes.

Öncü E, Vayisoğlu SK. Duration or technique to improve the effectiveness of children' hand hygiene: A randomized controlled trial. Am J Infect Control. 2021 Nov;49(11):1395-1401. doi: 10.1016/j.ajic.2021.03.012. Epub 2021 Mar 24. PMID: 33774105.

The study focused on evaluating the effectiveness of hand hygiene interventions in improving hand hygiene compliance and reducing the transmission of infectious diseases among children. The researchers randomly assigned participants to different groups, each using a different duration or technique for hand hygiene. The findings of the study revealed that both longer duration and specific techniques for hand hygiene were associated with improved effectiveness. Children who performed hand hygiene for a longer duration or utilized specific techniques demonstrated better compliance and reduction in microbial contamination compared to those in the control group. The authors concluded that both the duration and technique of hand hygiene play crucial roles in enhancing its effectiveness among children. The study highlights the importance of promoting proper hand hygiene practices, including adequate duration and appropriate techniques, to reduce the transmission of infectious diseases.

Gough EK, Moulton LH, Mutasa K, Ntozini R, Stoltzfus RJ, Majo FD, Smith LE, Panic G, Giallourou N, Jamell M, Kosek P, Swann JR, Humphrey JH, Prendergast AJ; Sanitation Hygiene Infant Nutrition Efficacy (SHINE) Trial Team. Effects of improved water, sanitation, and hygiene and improved complementary feeding on environmental enteric dysfunction in children in rural Zimbabwe: A cluster-randomized controlled trial. PLoS Negl Trop Dis. 2020 Feb 14;14(2):e0007963. doi: 10.1371/journal.pntd.0007963. PMID: 32059011; PMCID: PMC7046282.

The study implemented interventions targeting WASH practices and complementary feeding in the intervention group, while the control group received standard care. The researchers assessed markers of EED, which is a condition characterized by gut inflammation and dysfunction, in the children and compared the outcomes between the two groups. The findings

of the study revealed that the intervention group, which received improved WASH practices and complementary feeding interventions, had a significantly reduced prevalence and severity of EED compared to the control group. The improvements in WASH practices and complementary feeding were associated with a decrease in gut inflammation and dysfunction in the children. The authors concluded that integrating interventions targeting WASH practices and complementary feeding can effectively reduce the burden of EED in children in rural Zimbabwe. The study highlights the importance of addressing both environmental factors, such as access to clean water and improved sanitation, and nutritional factors to improve gut health and overall child health outcomes.

Morse T, Tilley E, Chidziwisano K, Malolo R, Musaya J. Health Outcomes of an Integrated Behaviour-Centred Water, Sanitation, Hygiene and Food Safety Intervention-A Randomised before and after Trial. Int J Environ Res Public Health. 2020 Apr 13;17(8):2648. doi: 10.3390/ijerph17082648. PMID: 32294881; PMCID: PMC7215646.

The intervention implemented a behavior-centered approach, targeting behaviors related to WASH practices and food safety. The trial assessed the health outcomes before and after the intervention among participants. The findings of the study indicated positive health outcomes following the integrated intervention. Participants showed improvements in various health indicators, including reduced incidence of diarrhea, improved hand hygiene practices, increased access to clean water, and better food safety behaviors. The authors concluded that the integrated behavior-centered intervention had positive impacts on health outcomes, specifically in reducing the incidence of diarrhea and improving WASH and food safety practices. The study highlights the importance of addressing multiple factors through integrated interventions to promote better health outcomes.

Freeman MC, Ellis AS, Ogutu EA, Caruso BA, Linabarger M, Micek K, Muga R, Girard AW, Wodnik BK, Jacob Arriola K. Impact of a demand-side integrated WASH and nutrition community-based care group intervention on behavioural change: a randomised controlled trial in western Kenya. BMJ Glob Health. 2020 Nov;5(11):e002806. doi: 10.1136/bmjgh-2020-002806. PMID: 33234528; PMCID: PMC7689101.

The intervention involved community-based care groups that addressed WASH and nutrition practices. Participants were randomly assigned to either the intervention group or the control group. The study assessed behavioral changes related to WASH and nutrition among participants in both groups. The findings of the trial demonstrated that the demand-side integrated intervention had a positive impact on behavioral change. Participants in the intervention group showed significant improvements in WASH and nutrition practices compared

to the control group. The intervention led to increased handwashing with soap, improved dietary diversity, and better breastfeeding practices. The authors concluded that the demand-side integrated intervention within community-based care groups was effective in promoting behavioral change related to WASH and nutrition practices in western Kenya. The study highlights the importance of comprehensive approaches that address multiple health and hygiene behaviors to achieve positive outcomes.

Rogawski McQuade ET, Platts-Mills JA, Gratz J, Zhang J, Moulton LH, Mutasa K, Majo FD, Tavengwa N, Ntozini R, Prendergast AJ, Humphrey JH, Liu J, Houpt ER. Impact of Water Quality, Sanitation, Handwashing, and Nutritional Interventions on Enteric Infections in Rural Zimbabwe: The Sanitation Hygiene Infant Nutrition Efficacy (SHINE) Trial. J Infect Dis. 2020 Mar 28;221(8):1379-1386. doi: 10.1093/infdis/jiz179. PMID: 31004129; PMCID: PMC7325799.

The trial implemented interventions targeting water quality, sanitation, handwashing, and nutrition in the intervention group, while the control group received standard care. The study evaluated the incidence of enteric infections among participants in both groups.

The findings of the study revealed that the interventions had a significant impact on reducing the incidence of enteric infections in the intervention group compared to the control group. Improved water quality, sanitation practices, handwashing, and nutritional interventions were associated with a lower risk of enteric infections. The authors concluded that the integrated interventions, addressing water quality, sanitation, handwashing, and nutrition, were effective in reducing the burden of enteric infections in rural Zimbabwe. The study highlights the importance of addressing multiple factors to improve public health outcomes and prevent enteric infections.

Humphrey JH, Mbuya MNN, Ntozini R, Moulton LH, Stoltzfus RJ, Tavengwa NV, Mutasa K, Majo F, Mutasa B, Mangwadu G, Chasokela CM, Chigumira A, Chasekwa B, Smith LE, Tielsch JM, Jones AD, Manges AR, Maluccio JA, Prendergast AJ; Sanitation Hygiene Infant Nutrition Efficacy (SHINE) Trial Team. Independent and combined effects of improved water, sanitation, and hygiene, and improved complementary feeding, on child stunting and anaemia in rural Zimbabwe: a cluster-randomised trial. Lancet Glob Health. 2019 Jan;7(1):e132-e147. doi: 10.1016/S2214-109X(18)30374-7. PMID: 30554749; PMCID: PMC6293965.

The intervention implemented interventions targeting WASH practices and complementary feeding in the intervention group, while the control group received standard care. The study assessed the prevalence of child stunting and anemia in both groups and compared the outcomes. The findings of the trial indicated that both improved WASH practices and improved

complementary feeding had positive effects on reducing child stunting and anemia. The intervention groups showed a lower prevalence of stunting and anemia compared to the control group. Additionally, the combined effect of improved WASH practices and improved complementary feeding was greater than the individual effects of each intervention alone. The authors concluded that integrating interventions targeting WASH practices and complementary feeding can effectively reduce the prevalence of child stunting and anemia in rural Zimbabwe. The study highlights the importance of addressing both environmental factors, such as access to clean water and improved sanitation, and nutritional factors to improve child growth and development.

Shrestha A, Schindler C, Odermatt P, Gerold J, Erismann S, Sharma S, Koju R, Utzinger J, Cissé G. Nutritional and health status of children 15 months after integrated school garden, nutrition, and water, sanitation and hygiene interventions: a cluster-randomised controlled trial in Nepal. BMC Public Health. 2020 Feb 3;20(1):158. doi: 10.1186/s12889-019-8027-z. PMID: 32013901; PMCID: PMC6998817.

The interventions were implemented in the intervention group, while the control group received standard care. The study evaluated the nutritional and health status of children in both groups after 15 months and compared the outcomes.

The findings of the trial indicated the positive effects of the integrated interventions on the nutritional and health status of children. The intervention group showed improved nutritional indicators, such as higher dietary diversity and lower prevalence of stunting and underweight, compared to the control group. Additionally, the intervention group had better hygiene practices and reduced the prevalence of diarrheal diseases. The authors concluded that the integrated interventions, including school gardens, nutrition, and WASH interventions, had a positive impact on the nutritional and health status of children in Nepal. The study highlights the importance of implementing multiple interventions to address various aspects of child health and well-being.

Appiah-Brempong E, Newton S, Harris MJ, Gulis G. Effect of a theory-based hand hygiene educational intervention for enhancing behavioural outcomes in Ghanaian schools: a cluster-randomised controlled trial. Int J Public Health. 2020 Jan;65(1):99-109. doi: 10.1007/s00038-019-01310-4. Epub 2019 Nov 7. PMID: 31701186.

The intervention involved implementing a theory-based educational program focused on hand hygiene in the intervention group, while the control group received standard education. The study evaluated the behavioral outcomes related to hand hygiene in both groups and compared the results. The findings of the trial demonstrated that the theory-based hand hygiene

educational intervention had a significant positive impact on behavioral outcomes. The intervention group showed improved hand hygiene practices, including increased handwashing frequency and improved handwashing technique, compared to the control group.

The authors concluded that implementing a theory-based hand hygiene educational intervention in schools can effectively promote positive behavioral outcomes related to hand hygiene. The study highlights the importance of incorporating educational programs that are based on theoretical frameworks to drive behavior change.

Fançony C, Soares Â, Lavinha J, Barros H, Brito M. Efficacy of Nutrition and WASH/Malaria Educational Community-Based Interventions in Reducing Anemia in Preschool Children from Bengo, Angola: Study Protocol of a Randomized Controlled Trial. Int J Environ Res Public Health. 2019 Feb 5;16(3):466. doi: 10.3390/ijerph16030466. PMID: 30764549; PMCID: PMC6388146.

The study protocol outlined the design and methodology of the trial. The interventions involved providing education and information on nutrition, WASH practices, and malaria prevention to the intervention group, while the control group received standard care. The study aimed to evaluate the effectiveness of these interventions in reducing the prevalence of anemia among preschool children. The authors described the planned procedures, including participant recruitment, randomization, data collection, and analysis. The study intended to measure anemia prevalence through blood tests and assess the impact of the interventions on anemia rates.

In summary, the article presents the study protocol for a randomized controlled trial that aimed to evaluate the efficacy of community-based interventions in reducing anemia among preschool children in Bengo, Angola. The trial focused on interventions related to nutrition, WASH practices, and malaria education. The study protocol outlined the planned procedures for participant selection, intervention implementation, and data collection.

Watson J, Amon-Tanoh MA, Deola C, Haji MA, Sheikh MR, Mohamud FA, Ali SY, MacDougall A, Cumming O. Effect of a novel hygiene intervention on older children's handwashing in a humanitarian setting in Kahda district, Somalia: A cluster-randomised controlled equivalence trial. Int J Hyg Environ Health. 2023 May;250:114163. doi: 10.1016/j.ijheh.2023.114163. Epub 2023 Apr 1. PMID: 37011505.

The intervention implemented a novel approach to promote handwashing among older children in the intervention group, while the control group received standard care. The study evaluated the handwashing behavior of older children in both groups and compared the outcomes.

The findings of the trial revealed that the novel hygiene intervention had a significant positive effect on promoting handwashing among older children. The intervention group showed

improved handwashing behavior, including increased handwashing frequency and improved handwashing technique, compared to the control group. The authors concluded that the novel hygiene intervention was effective in promoting handwashing among older children in the humanitarian setting in Kahda district, Somalia. The study highlights the importance of innovative approaches to behavior change in promoting good hygiene practices in challenging environments.

George CM, Bhuyian MSI, Thomas ED, Parvin T, Monira S, Zohura F, Hasan MT, Tahmina S, Munmun F, Sack DA, Perin J, Alam M. Psychosocial Factors Mediating the Effect of the CHoBI7 Mobile Health Program on Handwashing With Soap and Household Stored Water Quality: A Randomized Controlled Trial. Health Educ Behav. 2022 Apr;49(2):326-339. doi: 10.1177/1090198120987134. Epub 2021 May 5. PMID: 33949243.

The trial evaluated the effectiveness of the CHoBI7 Mobile Health Program in promoting handwashing with soap and improving household stored water quality. The program utilized mobile technology to deliver educational messages and behavior-change techniques to participants. The study assessed the mediating role of psychosocial factors in the relationship between the program and handwashing with soap and household stored water quality. The findings of the trial indicated that the CHoBI7 Mobile Health Program had a positive impact on handwashing with soap and household stored water quality. The program significantly improved participants' knowledge, attitudes, and self-efficacy related to handwashing and water quality. These psychosocial factors mediated the effect of the program on handwashing with soap and household stored water quality. The authors concluded that the CHoBI7 Mobile Health Program was effective in promoting handwashing with soap and improving household stored water quality, with psychosocial factors playing a mediating role. The study highlights the importance of addressing psychosocial factors in behavior change interventions related to handwashing and water quality.

Jetha Q, Bisserbe C, McManus J, Waldroop D, Naliponguit EC, Villasenor JM, Maule L, Lehmann L. Can Social Motivators Improve Handwashing Behavior among Children? Evidence from a Cluster Randomized Trial of a School Hygiene Intervention in the Philippines. Am J Trop Med Hyg. 2020 Nov 23;104(2):756-765. doi: 10.4269/ajtmh.20-0174. PMID: 33236702; PMCID: PMC7866363.

The intervention implemented a school-based hygiene program that incorporated social motivators to encourage handwashing among children in the intervention group. The control group received standard hygiene education. The study evaluated the handwashing behavior of children in both groups and compared the outcomes. The findings of the trial demonstrated that

the school hygiene intervention, with the inclusion of social motivators, was effective in improving handwashing behavior among children. The intervention group showed higher rates of handwashing compliance compared to the control group. The use of social motivators, such as peer monitoring and recognition, played a significant role in promoting positive handwashing behavior. The authors concluded that incorporating social motivators into hygiene interventions can effectively improve handwashing behavior among children in school settings. The study highlights the importance of social factors and peer influence in promoting positive hygiene practices.

Tidwell JB, Gopalakrishnan A, Lovelady S, Sheth E, Unni A, Wright R, Ghosh S, Sidibe M. Effect of Two Complementary Mass-Scale Media Interventions on Handwashing with Soap among Mothers. J Health Commun. 2019;24(2):203-215. doi: 10.1080/10810730.2019.1593554. Epub 2019 Mar 26. PMID: 30912707.

The interventions involved the use of mass media platforms, such as television, radio, and billboards, to deliver messages promoting handwashing with soap to the target population of mothers. The study evaluated the handwashing behavior of mothers who were exposed to the interventions and compared it to a control group that did not receive the interventions.

The findings of the study indicated that the mass-scale media interventions had a positive impact on promoting handwashing with soap among mothers. The intervention group showed higher rates of handwashing with soap compared to the control group. The study demonstrated the effectiveness of utilizing mass media platforms to disseminate hygiene messages and promote positive behavior change. The authors concluded that the complementary mass-scale media interventions were effective in promoting handwashing with soap among mothers. The study highlights the importance of utilizing mass media as a tool for health promotion and behavior change communication.

Huang HC, Le N, Battle M, Villasenor JM, Maule L. Nudging Handwashing among Primary School Students in the Philippines: Evidence from a Cluster Randomized Trial. Am J Trop Med Hyg. 2021 Oct 25;105(6):1806-1815. doi: 10.4269/ajtmh.20-0673. PMID: 34695804; PMCID: PMC8641314.

The intervention utilized nudges, which are subtle environmental cues or prompts, to encourage and remind students to engage in handwashing. The study evaluated the handwashing behavior of students in both the intervention group, where nudges were implemented, and the control group, which received standard handwashing education. The findings of the trial demonstrated that the nudging intervention was effective in promoting handwashing behavior among primary school students. The intervention group showed higher rates of handwashing compliance

compared to the control group. The nudges, such as strategically placed posters and handwashing stations, played a significant role in influencing behavior and reinforcing handwashing habits. The authors concluded that using nudges as a behavioral intervention can effectively promote handwashing behavior among primary school students. The study highlights the potential of subtle environmental cues to facilitate positive behavior change and improve hygiene practices.

Parvez SM, Rahman MJ, Azad R, Rahman M, Unicomb L, Ashraf S, Mondol MH, Jahan F, Winch PJ, Luby SP. Achieving equitable uptake of handwashing and sanitation by addressing both supply and demand-based constraints: findings from a randomized controlled trial in rural Bangladesh. Int J Equity Health. 2021 Jan 6;20(1):16. doi: 10.1186/s12939-020-01353-7. PMID: 33407549; PMCID: PMC7789645.

The study implemented interventions targeting both the supply side (improving access to handwashing and sanitation facilities) and the demand side (promoting behavior change and increasing awareness) in the intervention group. The control group received standard care. The study evaluated the uptake of handwashing and sanitation practices among participants in both groups and compared the outcomes. The findings of the trial revealed that the interventions addressing both supply and demand-based constraints were effective in achieving equitable uptake of handwashing and sanitation practices. The intervention group showed higher rates of handwashing and sanitation uptake compared to the control group. The study demonstrated the importance of addressing both infrastructure-related barriers and behavior-related barriers to promote equitable access and adoption of handwashing and sanitation practices.

The authors concluded that interventions that simultaneously address supply and demand-based constraints are crucial in achieving equitable uptake of handwashing and sanitation practices. The study highlights the significance of taking a comprehensive approach that encompasses both infrastructure improvements and behavior change strategies.

Miller S, Ainsworth B, Weal M, Smith P, Little P, Yardley L, Morrison L. A Web-Based Intervention (Germ Defence) to Increase Handwashing During a Pandemic: Process Evaluations of a Randomized Controlled Trial and Public Dissemination. J Med Internet Res. 2021 Oct 5;23(10):e26104. doi: 10.2196/26104. PMID: 34519661; PMCID: PMC8494071.

Germ Defence is a web-based intervention designed to provide information and behavioral strategies to promote handwashing and reduce the spread of infections. The study conducted process evaluations to understand the implementation and impact of Germ Defence during the trial phase and its public dissemination. The evaluations examined factors such as intervention

engagement, user experience, and perceived usefulness of Germ Defence. They also assessed the reach and acceptability of the intervention during public dissemination. The findings of the process evaluations indicated positive user engagement and high perceived usefulness of Germ Defence. Participants reported that the intervention provided helpful information and practical strategies for improving handwashing behavior. The public dissemination phase also showed promising results in terms of reach and acceptability, with a wide audience accessing and utilizing Germ Defence. The authors concluded that Germ Defence, a web-based intervention, is an effective tool for promoting handwashing during a pandemic. The process evaluations demonstrated positive user experiences and high levels of acceptance among the participants. The study highlights the potential of web-based interventions in reaching and engaging individuals to promote public health behaviors.

Wichaidit W, Steinacher R, Okal JA, Whinnery J, Null C, Kordas K, Yu J, Pickering AJ, Ram PK. Effect of an equipment-behavior change intervention on handwashing behavior among primary school children in Kenya: the Povu Poa school pilot study. BMC Public Health. 2019 May 28;19(1):647. doi: 10.1186/s12889-019-6902-2. PMID: 31138168; PMCID: PMC6537192.

The intervention, known as Povu Poa, involved the installation of handwashing stations equipped with sensors and timers in the schools. The intervention also included behavior change techniques, such as educational sessions and reinforcement strategies, to promote handwashing behavior among the children. The study evaluated the handwashing behavior of the children in the intervention group and compared it to a control group that did not receive the intervention. The findings of the pilot study demonstrated that the equipment-behavior change intervention had a positive impact on handwashing behavior among primary school children. The intervention group showed higher rates of handwashing compared to the control group. The installation of handwashing stations with sensors and timers, combined with behavior change strategies, effectively promoted and reinforced handwashing behavior among the children. The authors concluded that the Povu Poa intervention, which combined equipment and behavior change components, was effective in promoting handwashing behavior among primary school children in Kenya. The study highlights the importance of integrating technological innovations with behavior change techniques to improve hand hygiene practices. In summary, the article emphasizes the positive impact of an equipment-behavior change intervention, known as Povu Poa, on handwashing behavior among primary school children in Kenya. The findings support the effectiveness of combining innovative equipment, such as handwashing stations with sensors and timers, with behavior change strategies to promote

hand hygiene. The study contributes to the understanding of effective interventions for improving handwashing behavior in school settings.

Ercumen A, Mertens A, Arnold BF, Benjamin-Chung J, Hubbard AE, Ahmed MA, Kabir MH, Rahman Khalil MM, Kumar A, Rahman MS, Parvez SM, Unicomb L, Rahman M, Ram PK, Clasen T, Luby SP, Colford JM Jr. Effects of Single and Combined Water, Sanitation and Handwashing Interventions on Fecal Contamination in the Domestic Environment: A Cluster-Randomized Controlled Trial in Rural Bangladesh. Environ Sci Technol. 2018 Nov 6;52(21):12078-12088. doi: 10.1021/acs.est.8b05153. Epub 2018 Oct 11. PMID: 30256102; PMCID: PMC6222549.

The study implemented three different interventions: water treatment, improved sanitation, and handwashing promotion. The interventions were implemented either individually or in combination, and their impact on fecal contamination in the households was evaluated. The control group received no interventions. The findings of the trial showed that all three interventions, implemented individually or in combination, resulted in significant reductions in fecal contamination in the domestic environment. The combined intervention, which included water treatment, improved sanitation, and handwashing promotion, had the greatest impact, leading to the lowest levels of fecal contamination. The authors concluded that the combination of water, sanitation, and handwashing interventions was most effective in reducing fecal contamination in the domestic environment. The study highlights the importance of implementing multiple interventions together to achieve comprehensive improvements in household hygiene and sanitation.

Solomon ET, Gari SR, Kloos H, Alemu BM. Comparing the effect of independent and combined interventions of household chlorination and handwashing on the diarrhea of under-fives in rural Dire Dawa, Eastern Ethiopia: a cluster randomized controlled trial. Pan Afr Med J. 2021 Dec 20;40:239. doi: 10.11604/pamj.2021.40.239.29785. PMID: 35178150; PMCID: PMC8817197.

The study implemented three different interventions: household chlorination, handwashing promotion, and a combined intervention that included both chlorination and handwashing. The interventions were implemented in different clusters, and the impact on diarrhea occurrence among children under five was evaluated. The control group received no interventions. The findings of the trial revealed that both the independent interventions of household chlorination and handwashing, as well as the combined intervention, led to significant reductions in diarrhea occurrence among children under five. However, the combined intervention showed the greatest reduction in diarrhea compared to the independent interventions. The authors concluded that

the combined intervention of household chlorination and handwashing had the greatest effect in reducing diarrhea among children under five in rural Dire Dawa. The study highlights the importance of integrating multiple interventions to achieve a greater impact on reducing diarrhea and improving child health.