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Scholarly Report Title: An applied investigation into effective health education: Creating an educational toolkit to raise awareness of schistosomiasis among children living in Zambian peri-urban slum communities

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An applied investigation into effective health education: Creating an educational toolkit to raise awareness of schistosomiasis among children living in Zambian peri-urban slum communities

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Purpose: Poor water sanitation and waste management in the peri-urban slum compounds of Lusaka, Zambia have directly contributed to a significant schistosomiasis prevalence rate of 20.72%. According to the rational model and other international education-based health initiatives, a school-based health education campaign dedicated to raising awareness can potentially serve as an effective form of disease prevention. We are thus investigating the components necessary to empower teachers of young elementary students to serve as health educators about schistosomiasis in the setting of impoverished slum communities.

Methods: A training workshop focused on the topics of water sanitation, waste management, and schistosomiasis was held for teachers from six of Zambia's peri-urban slum communities. Teacher knowledge attainment and perceptions were assessed. Lesson plans stemming from the workshop were implemented in the classroom setting, accompanied by student knowledge assessments. A literature review was subsequently performed to understand the foundations of health education, identify verified teaching techniques, and evaluate the role of cultural, age-based, and personal learning differences. An educational toolkit was ultimately developed incorporating the needs and preferences of the Zambian teachers and the literature review findings.

Results: The average percentage of the pre- and post-training teacher knowledge questionnaires rose from 49% to 59% ($p=0.29$). More notably, the pre-training percentages ranged from 15% to 74% and the post-training percentages ranged from 26% to 79%. After the implementation of classroom lesson plans, the students showed statistically significant increases in nine of fifteen knowledge questions. Qualitatively, teachers asked for additional workshops, classroom resources, and help with basic teaching skills. Literature review supported the potential of health education campaigns, discouraged any emphasis on cultural variations or learning styles, and emphasized teacher preparation as fundamental to successful curricular implementation.

Conclusions: In consideration of varying levels of educational achievement among the teachers and a resource-limited setting, three factors were identified as necessary for empowering teachers to propagate schistosomiasis awareness: teacher training workshops, appropriate teaching aids, and comprehensive lesson plans. For future endeavors, an educational toolkit was synthesized that, if validated, may serve as a model for analogous peri-urban slum communities suffering from high rates of schistosomiasis.

Table of Contents

[1] The term 'bilharzia' is used widely in Zambia in lieu of 'schistosomiases'. All questionnaires, surveys, and toolkit content materials use the terms interchangeably.

Section 1: Introduction

According to the Centers for Disease Control and Prevention, access to safe water and hygienic sanitation facilities is considered to be a human right, not a privilege. Nonetheless, worldwide, 780 million people do not have access to an improved water source and only 63% of the world's population uses improved sanitation facilities [1]. These figures represent a significant concern considering that water, sanitation, and hygiene have the potential to prevent at least 9.1% of the global disease burden and 6.3% of all deaths [2]. Countries challenged by the requisite to fulfill water sanitation and waste management needs leave people at risk for water, sanitation, and hygiene-related diseases, including schistosomiasis [1].

According to the Centers for Disease Control and Prevention, with respect to disease impact, schistosomiasis is second only to malaria as the most devastating parasitic disease in the world. More than 200 million people are infected worldwide. Young children constitute the most susceptible population to schistosomiasis as they tend to spend more time swimming, bathing, or playing in freshwater contaminated with fecal matter, the parasite's site of propagation. Children who are infected are at risk of developing anemia, malnutrition, and learning difficulties. After years of infection, the parasite can also damage the liver, intestine, lungs, and bladder [3].

In the setting of limited access to safe water and hygienic sanitation facilities, the children of Zambia's peri-urban slums have been found to be particularly vulnerable to schistosomiasis. The peri-urban slums skirting Lusaka are characteristically over-populated squatter compounds that lack an established water supply and waste management infrastructure. Although efforts to deliver piped water to community taps have recently been made, the supply is often erratic, inadequate, and restricted [4].

A health assessment conducted in 2007 of 1583 children from nine of Lusaka, Zambia's peri-urban compound schools revealed a schistosomiasis prevalence rate of 20.72% based on the presence of schistosome ova in urine. In contrast, the study reported that after history acquisition and physical examination alone, the clinical officers detected schistosomiasis with a sensitivity of 24.70% and a specificity of 98.17%. These results highlighted that peri-urban children have a significant but under-

recognized vulnerability to infection. History and physical examination alone are inadequate for identifying a treatment population. Moreover, an analysis of data attained from the local clinic demonstrated a lack of care sought for schistosomiasis symptoms, indicating incongruence between the rate of infection and the prioritization of disease treatment within the compound communities [4].

Linked to absenteeism from school and cognitive delays, schistosomiasis impedes the societal and personal benefits associated with education for these young children [5]. While schistosomiasis can be easily and effectively treated with a single dose of praziquantel, studies show that treatment alone cannot eradicate the cumulative effects of chronic infection nor compensate for missed learning opportunities [6]. Additionally, there has been no significant investigation into the impact of treatment on the rate of reinfection among Zambian children. Acknowledging the physical environmental limitations of poor water sanitation and waste management, a greater focus on early prevention, by means of increasing knowledge and awareness, may help lead to both health and educational benefits for these at-risk children.

Numerous studies have detailed the benefits of school-based health education campaigns. These programs achieve cost-effectiveness as they take advantage of a pre-existent educational infrastructure for their implementation [7, 8]. Furthermore, many have demonstrated the successes of training lay people, including teachers, as community health workers equipped with the ability to disseminate health-based education [9, 10, 11]. The positive potential of a school-based health education campaign is elucidated by "the rational model." This model, also known as the "knowledge, attitudes, practices model," is based on the principle that increasing a person's knowledge will prompt a behavior change [12].

With a foundation in the rational model, it was thus the intent of this scholarly project to address the high prevalence of schistosomiasis among young Zambian children living in peri-urban slum communities by means of a school-based health education campaign. Significantly, educating this age group presents a particular challenge in terms of cognition, mental ability, and attention. Therefore, a more significant emphasis on the model and strategies of teaching and the precise curriculum chosen must be made [13]. Furthermore, conditions in peri-urban slums present a unique obstacle to health promotion

programs, as they are generally informal and unplanned settings that are over-populated and under-serviced [14]. The resulting scholarly question: in the setting of impoverished slum communities, what is an effective means of empowering teachers of young elementary students to serve as health educators about schistosomiasis?

Section 2: Student Role

A. Teacher training workshop

A two day teacher training workshop was conducted in coordination with a Zambian health promotion training team. The training team was largely responsible for the material presented on the first day, while I was responsible for that of the second. I thereby created and presented both the review material and the competitive group game. The second day also included teacher presentations and feedback, which was provided by both me and the training team. I also created the knowledge questionnaire and satisfaction survey administered to the teachers.

B. Classroom lesson plan implementation

Following the training workshop, the teachers were asked to implement their lesson plans in the classroom setting. I created knowledge questionnaires for the students that were administered both before and after lesson plan implementation. Due to the language barrier, I was unable to administer the questionnaires myself. I also created the post-lesson plan implementation satisfaction survey administered to the teachers.

I visited each school at least two times and partook in a walking tour of each compound with a teacher. This gave me the chance to evaluate the resources of each classroom and school. I was also able to garner an appreciation of the water and sanitation facilities of each compound community.

C. Quantitative and Qualitative Assessment

I completed the data entry for both pre-/post-training teacher knowledge questionnaires and pre-/post-lesson plan implementation student knowledge questionnaires. I was assisted in the data's statistical analysis by Zhigang Lu, MD, a research scientist at Brigham and Women's Hospital. I personally reviewed the qualitative data.

D. Literature Review

Better understanding the resource limitations and lack of educator training among the Zambian teachers after physically travelling to Zambia, I decided to undertake a literature review to become more familiar with the discipline of education and effective teaching techniques. I first met with references librarians at the Monroe C. Gutman Library to better understand which education-focused databases would be most applicable and valuable with respect to my project. I subsequently proceeded with my literature review.

E. Toolkit Development

I combined my experiential knowledge, the stated needs and preference of the teachers, and my literature review findings to create an educational toolkit focused on the topics of water sanitation, waste management, and schistosomiasis. I modeled the background information on health education training material currently being taught to teachers in Zambia's Ngombe compound by the non-governmental organization Healthy Kids/Brighter Future. I created lesson plans and suggested student assessments for each topic. The instructional aids I included either came directly from or were inspired by teachers that participated in the training workshop.

Section 3: Methods

This investigation was financially supported by Harvard Medical School and the Harvard Committee on African Studies. It was logistically sustained by Communities Without Borders (CWB), a non-governmental organization registered in both the United States of America and Zambia. Founded in 2000, the mission of CWB is to support the education of HIV orphans and other vulnerable children living in the peri-urban slum communities of Lusaka, Zambia. At the time of this investigation, Communities Without Borders was closely affiliated with and sponsoring six primary schools located in Lusaka's peri-urban slum communities. CWB furthermore had an established relationship with a local health promotion training team based out of the N'gombe compound health clinic.

With respect to future endeavors and sustainability, a relationship has been established with Healthy Kids/Brighter Future (HK/BF), a non-profit organization that strives to bring school-based

medical care and health education to the marginalized children of Zambia. HK/BF has recently initiated a health training curriculum for the teachers of the N'gombe slum community, which contains 35 community schools and serves over 10,000 students. Notably, the training is largely facilitated by the same Zambian health promotion training team familiar to CWB.

A. Teacher training workshop

The fifteen teachers of CWB's six peri-urban slum community schools were invited to participate in a two-day training workshop. Participation was incentivized through a small stipend, meal and transportation provisions, and workshop certification. Sociodemographically, the teachers were mostly community volunteers who began teaching following completion of secondary school and typically lacked formal training in educational instruction and development.

A local health promotion training team was contracted to co-facilitate in consideration of language and cultural barriers. Three core topics were highlighted: water sanitation, waste management, and schistosomiasis.

On day one, the local health promotion training team discussed communication strategies, lesson plan development, and the three core topics. Communication strategies encouraging the use of the question/answer presentations and the fundamentals of lesson plan development were emphasized. The three core topics were examined through discussions of the water ladder, hand washing rules, the solid waste ladder, sanitation strategies, routes of disease transmission, and shistosomiasis signs, symptoms, transmission, prevention, and treatment. The teachers were subsequently asked to complete three documents: 1. a pre-training knowledge questionnaire, 2. a post-training knowledge questionnaire, and 3. a post-training satisfaction survey. The pre- and post-training knowledge questionnaires were identical, consisting of ranking, multiple choice, yes/no, true/false, and open-ended questions. Ultimately, each teacher was instructed to use the material learned on day one to create a lesson plan applicable to their students.

On day two (1.5 weeks after day one), in recognition of the teachers' difficulty with the material based on the pre-/post-training knowledge questionnaire results, a PowerPoint presentation and

competitive group game were employed to review and reinforce the three core topics, respectively. The PowerPoint presentation was created to parallel the questions posed by the teacher knowledge questionnaire. The competitive group game asked the teachers to discuss and answer multiple choice questions as teams competing for fictional points and to furthermore explain the reasoning behind their answers. The teachers subsequently presented their developed lesson plans, using their audience of colleagues to simulate their students. Each teacher was provided with personalized feedback.

B. Classroom lesson plan implementation

Following the teacher training workshops, the teachers were asked to modify their lesson plans based on the feedback received and implement them in the classroom setting.

Prior to lesson plan implementation, each child was asked to complete an oral knowledge-based questionnaire. Since the pre-lesson plan implementation knowledge questionnaires were administered in conjunction with a yearly CWB preventative health screening assessment, local Zambian nurses and nurse's aides were available to administer the questionnaire in a one-on-one format. Following lesson plan implementation, within a two-week window, each site was revisited and local Zambian medical students were contracted to administer the post-implementation knowledge questionnaire. The post-implementation knowledge questionnaire was similarly administered in a one-on-one oral format. The pre- and post-lesson plan implementation knowledge questionnaires were identical, consisting of multiple choice and yes/no formatted questions.

The teachers were asked to complete post-lesson plan satisfaction surveys.

C. Quantitative and Qualitative Assessment

Data entry was completed systematically for both pre-/post-training teacher knowledge questionnaires and pre-/post-lesson plan implementation student knowledge questionnaires. Analysis of variance (ANOVA) and chi-square analyses were applied.

Qualitative data was reviewed for trends in the teachers' perceptions of the training workshops, implementation difficulties, and classroom health education feasibility.

D. Literature Review

Confronted with the resource limitations of the peri-urban slum setting and the lack of educator training of the teachers, a literature review was prompted on return to the United States of America to better understand the discipline of education and the founding blocks of structuring a curriculum. Specifically, a literature review was conducted to research validated teaching techniques, understand cultural, age-based, and personal learning differences, and identify examples or references for curriculum development. The Harvard Graduate School of Education's online "3-in-1 Education Articles Search" via ESCBOhost was employed to simultaneously search through three scholarly educational databases: Academic Search Premier, Education Abstracts (H.W. Wilson), and Education Resources Information Center (ERIC). The following search phrases were employed in varying combinations: "Zambia(n)," "learning style(s)," "cognitive style(s)," "health education," "culture," "Africa(n)," "learning," "teaching," "elementary," and "child(ren)." Full-length, peer-reviewed articles were chosen based on their relevance. Supplemental literary material focused on "curriculum development" and "international health education" was selected according to Harvard University HOLLIS availability.

E. Toolkit Development

In accordance with the needs, ideas, and preferences expressed by the Zambian teachers and the teaching techniques and models identified by literature review, an educational toolkit was constructed. The toolkit is focused on the three core topics of water sanitation, waste management, and schistosomiasis. Each lesson module was created to include:

- Background information: an explanation of the lesson's content for the teachers.
- Action plan: a description of how the lesson should be effectively implemented.
- Teaching aid: a physical resource to aid in instruction (poster, book, song, etc).
- Student assessments: evaluative material or activities for assessment purposes.

Section 4: Results

Training Workshop and Teacher Feedback

All fifteen teachers from six schools located in the peri-urban slum communities of Lusaka, Zambia were invited to participate in a two-day training workshop. Eleven of the fifteen teachers arrived

punctually and were able to complete both pre- and post-training knowledge questionnaires. All fifteen completed a post-training satisfaction survey.

Table 1 displays the eleven matched results of the pre- and post-training knowledge questionnaires: the raw score and percentage for each teacher at the beginning and at the conclusion of the first day of the workshop. In short, eight teacher's scores improved, one teacher's score remained the same, and two teacher's scores decreased. The average percentage rose from 49% to 59% but by ANOVA analysis the difference was not found to be statistically significant (F ratio 1.14, F crit 4.35, p=0.29). However, there did appear to be wide knowledge variations between the teachers, with the pre-training percentages ranging from 15% to 74% and the post-training percentages ranging from 26% to 79%.

All questions in the post-training satisfaction survey were open ended in format. Fifteen teachers participated and trends were assessed. Twelve teachers predicted that lesson plans stemming from health information learned in the workshops would be feasible and impactful for their students. Four teachers encouraged more health-based training workshops and three requested workshops for basic training in teaching. Moreover, three noted needing more help with lesson plan development and three proposed making further reference material available. Finally, in terms of the workshop's overall structure, three emphasized being particularly happy with the level of engagement, the use of group activities, and the open exchange of ideas.

On the second day of the workshop, a review PowerPoint presentation and competitive group game were employed to emphasize the key learning points, clarify misconceptions, and further bridge knowledge gaps. The teachers had been asked to create lesson plans focused on the topics of water sanitation, waste management, and schistosomiasis. Of the twelve teachers that attended the second workshop, ten arrived prepared with a lesson plan. Four teachers taught didactically, four employed visual aids, one recited a poem, and one created a story. Each lesson plan was evaluated by the health promotion-training team and the other teachers.

The teachers were subsequently asked to modify their lesson plans based on the feedback provided and use them in the classroom setting to teach their students. After implementation, the teachers

completed another satisfaction survey. Ten surveys were completed and trends were assessed. Five teachers emphasized the importance of having proper visual aids to better illustrate concepts for their students. They described creating their own drawings but at times struggling with respect to artistic ability. Songs, poems, drama, dance, a movie viewing, and a community field trip were listed as suggested alternative methods of health education. In terms of impact, three teachers described the transfer of information from the students to their peers and parents. As one teacher noted, "some parents came to confess that their children advised them to stop washing in stream, that they stopped urinating in water, and that they should not throw garbage in water." Moreover, three teachers described an appreciation for an increase in their own knowledge.

Classroom Lesson Plan Implementation and Student Results

Both before and after the lesson plans were implemented, an oral knowledge questionnaire was administered to the students of the six schools whose teachers had participated in the training workshop. While the age of the children varied, approximately 50% were 5-9 years of age (Table 2). A total of 357 pre-implementation and 325 post-implementation questionnaires were administered. Only 171 were matched (both pre- and post-implementation completed) and the degree of questionnaire completion varied. Thus, in order to include as many data points as possible, the pre-implementation results were compared as a group to the post-implementation results for each individual question.

Table 3 annotates the student knowledge questionnaire questions and the responses with corresponding statistical analysis.

Literature Review on Health Education and Teaching Techniques

A considerable body of evidence highlights the advantages of school health programs in improving the health of populations and promoting health capital [12]. As a unique attribute, they also often offer their greatest benefits to the poorest children. This concept is founded on the idea of a differential impact. As such, even when a disease reaches wealthy and impoverished children similarly, the impoverished are more likely to experience a disruption to their learning. This is founded on the theory that impoverished children begin with a lower coping threshold, struggling to pursue education in

the setting of limited physical resources and poor general health conditions. The marginal impact of a new infection may be intolerable both physically and financially. Health education in the school setting thus may prove an effective intervention for these children by means of early prevention [6, 8].

While the concept of school health programs is generally lauded, there is ongoing investigation into the pragmatic components necessary for efficacy. When developing a curriculum, for example, differential learning styles and cultural variations are often considered. However, more recently, educational researchers have argued that learning styles theory perpetuates overgeneralizations, as even within the same culture individuals will differ with respect to ability, background knowledge, and interest [15, 16]. Rather, a teacher's time is more effectively spent using a variety of teaching methods to appeal to natural differences among students or using evidence based techniques like inquiry-based learning [17]. Ultimately, the teacher is the underpinning and indispensable element of any educational endeavor [13, 18]. In fact, effective health curriculum implementation has been directly related to the presence and length of teacher training workshops [13, 19]. Training workshops provide teachers the opportunity to increase their own knowledge of the curricular content, to create instructional material, and to participate in the educational experience they will replicate in their classroom [19].

Creating a pragmatic and efficacious school health program is further complicated by the task of targeting a younger elementary population. With respect to lesson plan structure, children of 4-7 years of age generally have difficulty sitting still for more than fifteen minutes. They require a variety of activities that permit changes in body position. With respect to content, they typically require repetition and reinforcement and can respond more favorably to a sense of entertainment [20]. It is furthermore valuable to consider that when assessing knowledge attainment, reading skill and comprehension can hinder evaluation of academic content [13]. Hence assessment in the form of products (projects, written reports, and exhibits), performance (drama, demonstration), and process focus (class participation, learning log, interview) may be more authentic and informative than standard response test items (multiple choice, true/false, label a diagram) [19].

Section 5: Discussion

Evaluation of Teacher Training Workshop and Teacher Responses

During the course of the training workshop a pre- and post-training knowledge questionnaire was used to assess the transmission of content to the teachers. Yet, perhaps more striking than the matched differences before and after training was the sheer range of differences among the teachers, as depicted in Table 1. As a testament to the need for a training workshop, this finding indicates that much of the material presented in the workshop was potentially novel information for many of the teachers. The teachers, as representative of their larger compound communities, reflect the inconsistent understanding present regarding the topics of water sanitation, waste management, and schistosomiasis. Logically, in order to implement a successful school health program, the teachers being asked to disseminate the health-based information must first comprehend the material themselves.

The wide range likely also alludes to the varying levels of educational achievement of the teachers. Most begin teaching following the completion of secondary school. Very few of the teachers have any formal training in educational instruction or development. Recognition of this discrepancy rationalizes the survey request for more workshops focused on basic training in teaching and the noted need for assistance with lesson plan development. This also emphasizes the repeated appeal for classroom reference material, as the challenge of incorporating novel content may be further compounded when also asked to create instructional material with limited resources.

With respect to the impact of the training workshop as assessed by the knowledge questionnaire, eight teacher's scores improved, one teacher's score remained the same, and two teacher's scores decreased. The lack of statistically effective learning by the teachers may be partially attributable to the workshop content being taught in a manner that overestimated the teachers' basic health and scientific knowledge. Additionally, the knowledge questionnaire was administered during the first day of the training workshop, which was largely led by the Zambian health promotion training team. Admittedly a study design flaw: while the training team reviewed the questionnaire prior to the first day of the workshop, they were not directly involved in its composition due to the barriers of transcontinental

communication. Thus the content highlighted during the training may not have directly corresponded with the content emphasized in the questionnaire. In recognition of the teachers' difficulty with the material, a PowerPoint presentation and competitive group game were employed on the second day of the workshop to review and reinforce the concepts. Ongoing training may help to further reinforce concepts and improve teaching techniques.

Despite the lack of statistical efficacy, the workshop was nevertheless positively perceived as engaging, encouraging the open exchange of ideas through the use of group activities. The majority of the teachers were hopeful that lesson plans stemming from health information learned in the workshops could be feasibly implemented in the classroom to positively influence their students. As a measure of their enthusiasm, ten out of twelve teachers attending the second day of the workshop came prepared with lesson plans.

Evaluation of Student Knowledge Attainment

The ultimate purpose of empowering Zambian teachers to serve as health educators about schistosomiasis is to reduce the high prevalence of the disease among the children in peri-urban slum communities. Founded in the rational model, the goal is to achieve prevention by increasing the students' knowledge and thereby instigating a change in their attitudes and behaviors. As displayed in Table 3, many of the questions administered in the pre- and post-lesson plan implementation questionnaire revealed a statistically significant increase in knowledge among the students. They were better able to identify appropriate timing for hand washing, poor methods of human-waste disposal, and details about schistosomiasis. Ironically, there was also a statically significant decrease in the number of children able to identify how hand hygiene prevents disease. More students indicated that handwashing prevents germs from crossing the skin barrier than that it prevents germs from ultimately being ingested via the mouth. This element of confusion may have stemmed from a discussion of how schistosomiasis is contracted.

In addition to the presence of a quantitative increase in knowledge, the post-implementation teacher surveys revealed a more qualitative impact. The teachers described observing the transmission of the health-based information from the students to their peers and parents. One teacher even recollected

parents coming to the school to inform her of habits they had not previously perceived as harmful (urinating, washing, and disposing of waste into bodies of water) but through the influence of their children were now trying to change. Moreover, the teachers reinforced an appreciation for an increase in their own knowledge of the health-based topics and a desire to share that understanding with their communities.

Moving Forward-Propagating Schistosomiasis Awareness

The combination of the qualitative and quantitative data gathered in Zambia with the findings made through literature review have led to the recognition of several factors necessary for propagating the increased awareness of schistosomiasis hitherto achieved.

First and foremost is teacher training. As representative members of their peri-urban slum communities, the teachers portray inconsistent understanding with respect to the topics of water sanitation, waste management, and schistosomiasis. In order for them to be able to spread information about these topics to their students, it must first be ensured that the teachers themselves understand the material. The forum of a training workshop not only serves as a structured means of increasing curricular content comprehension, but also allows teacher the ability to interact with and learn from colleagues and to participate in the educational experience they will replicate in their classroom. The teachers themselves appealed for further training and more workshops, indicating the opportunity to garner teacher enthusiasm and investment in the health education campaign.

The second vital factor is the distribution of teaching aids. In the peri-urban slum setting, physical and financial resources are limited. Many teachers created their own visual aids and songs to better illustrate the concepts the wished to teach their students. However, others noted the difficulty of developing such aids when restricted not only by resources but also artistic ability. In the setting of challenging a teacher to first understand and then introduce a new topic into their classroom, further requesting the time and energy of creating a teaching aid can weigh heavy as an additional burden. Repeatedly, in each of the surveys administered, the teachers asked for classroom resources.

The final factor is the dissemination of comprehensive lesson plans. As detailed above, some teachers begin teaching following the completion of secondary school while a few have achieved higher degrees in educational instruction. Accordingly, teachers involved in the training workshop requested instruction in basic teaching skills and help with basic lesson plan development. Providing lesson plans founded on evidence-based teaching techniques confers several benefits. Most simply, the teachers' limited time is preserved and the incorporation of schistosomiasis teaching is not viewed as an obstacle. Moreover, the teachers may learn a new teaching technique by means of the provided lesson plans. Finally, the comprehensive lesson plans can serve as a reference for future work.

In preparation for future endeavors, the above factors were taken into consideration to create a model educational toolkit for spreading schistosomiasis awareness (Appendix 5). The hope is that the toolkit will be implemented under the auspices of Healthy Kids/Brighter Future (HK/BF). HK/BF has expressed the sentiment that while they have newly initiated a health training curriculum for the teachers of the N'gombe slum community, there remains a need for classroom resources and lesson plans, a need consistently echoed by their teachers. Thus the toolkit was created to fill this niche within the setting of an established teacher training system. The toolkit includes review material for the teachers that parallels their training material, lesson plans founded in inquiry-based learning techniques designed for a younger school age group, teaching aids inspired by the teachers who partook in the original schistosomiasis training workshop, and student assessment suggestions for monitoring and evaluation.

Limitations

Many limitations were encountered during the undertaking of this scholarly project. At a fundamental level, while English is Zambia's official language, there are several major indigenous languages that are widely spoken. The presence of a language barrier inhibited several aspects of the project. With regards to the training workshop, partnership with a local Zambian health promotion training team was required to ensure appropriate and intelligible communication. While the training team certainly assisted in bridging the language and cultural divide, there were indications of discrepancies between the training team's curriculum focus and the workshop's intended health teachings (teacher

knowledge questionnaire results). Additionally, the language barrier necessitated procuring assistance with the administration of the oral student knowledge questionnaire. Due to resource limitations, individuals from different disciplines were recruited to administer the pre- and post-lesson plan implementation knowledge questionnaires. Unfortunately, this challenge made it difficult to ascertain if the questionnaire was translated consistently between the nurses, nurse's aides, and medical students. Resource restrictions in Zambia prohibited the translation and reprinting of the questionnaires from English to the major indigenous languages.

The structure of the peri-urban slum community schools presented their own limitations. Student attendance varied drastically at each school, ultimately resulting in 171 matched student knowledge questionnaires, despite 357 pre-implementation and 325 post-implementation questionnaires being administered. Additionally, the degree of questionnaire completion varied, again suggesting the potential of inconsistent administration as well as alluding to the wide age range of the students, with the impact of older students understanding more complex concepts and more fully completing the questionnaires. The limitation of matched questionnaires led to the use of a convenient sample, evaluating each question based on grouped pre- and post-results. Furthermore, although there was variation in teacher ability demonstrated during the training workshop, there were not enough matched results at each school to permit statistical analysis. Finally, because the knowledge questionnaires were administered while conducting general health assessments, some of the students that partook in the knowledge questionnaire fell above and below the project's targeted student age group.

Perhaps the most significant limitation of this project was the reliance on the theory of the rational model. Again, the assumption is that an increase in knowledge will instigate a change in attitudes and behaviors. Unfortunately, this model may be largely hindered by the environmental reality of the peri-urban slum setting. For example, if the children lack soap to wash with or identify few extracurricular activities other than swimming in open bodies of water, the perceived threat of infection may be minimized and ultimately ignored. Simply stated, the environment may overwhelm the practice of new knowledge and behaviors. Ideally, having reached an appraisal of necessary factors for propagating

schistosomiasis awareness within a school health campaign and created a model educational toolkit, the next step would be to implement the toolkit under the umbrella of HK/BF while monitoring for schistosomiasis prevalence changes. Unfortunately, both scheduling and financial restrictions prohibit such an undertaking at this time. Hopefully another student will be able to carry forward the project and implement a pilot of the toolkit. This would allow for theoretical validation, toolkit revision, and possible application to similarly impoverished sites internationally.

Conclusion

Poor water sanitation and waste management in the peri-urban slum compounds of Lusaka, Zambia have directly contributed to high prevalence rates of schistosomiasis, wherein one in every five child is infected and, yet, disproportionality fewer seek treatment [4, 14]. As a result, these children are at risk of suffering from many negative health effects as well as cognitive and developmental delays. According to the rational model, an increase in knowledge has the potential to modify attitudes and behaviors. Thus, a school-based health education campaign focused on at-risk children can potentially serve as an effective form of disease prevention. The integration of onsite experience with literature review has identified three key factors necessary for propagating schistosomiasis awareness in the peri-urban slum classroom setting: teacher training, appropriate teaching aids, and comprehensive lesson plans. These three key factors serve to increase teacher knowledge, garner teacher enthusiasm, and simplify proper curriculum implementation. For future endeavors, an educational toolkit has been developed that, if validated, may serve as a foundation for analogous peri-urban slum communities suffering from high rates of schistosomiasis.

Section 6: Acknowledgements

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The future of this project rests in the capable hands of Health Kids/Brighter Future (HK/BF), with whom we are excited to share the schistosomiasis toolkit.

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Tables

Table 1. Teacher training knowledge questionnaire results

Pre-training Raw Score	Pre-training Percentage	Post-training Raw Score	Post-training Percentage	Change in Raw Score
25/34	74	24/34	71	-1
24/34	71	27/34	79	+3
23/34	68	26/34	76	+3
23/34	68	23/34	68	0
20/34	59	22/34	65	+2
19/34	56	28/34	82	+9
17/34	50	15/34	44	-2
11/34	32	20/34	59	+9
10/34	29	16/34	47	+6
7/34	21	9/34	26	+2
5/34	15	10/34	29	+5

Table 2. Student age distribution

	Number of students	Mean Age	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
Pre-implementation knowledge questionnaire	357	7.1	2.7	2	5	6	8	18
Post-implementation knowledge questionnaire	325	7.2	3.1	2	5	6	9	20

Table 3. Student knowledge questionnaire results--Percent correct by question

Question	Pre-implementation knowledge questionnaire	Post-implementation knowledge questionnaire	p Value
1. Water source	33.93%	32.14%	0.1736
2. Hand washing and disease prevention	27.20%	19.76%	0.0004
3. Hand washing timing:			
a. After defecation	52.13%	47.58%	0.1773
b. After bathing	16.24%	28.17%	<0.0001
c. Before eating	52.37%	47.48%	0.3414
d. Before handling food	51.42%	47.09%	0.0805
e. Before playing outside	18.09%	31.24%	<0.0001
4. Waste disposal	18.94%	26.21%	<0.0001
5. Bilharzia facts:			
a. Waterborne disease	23.20%	45.32%	<0.0001
b. Susceptibility	31.39%	56.71%	0.2270
c. Transmission-snails	31.65%	50.95%	0.0031
d. Transmission-human waste	31.38%	63.27%	<0.0001
e. Treatment	25.78%	59.38%	<0.0001
f. Signs and symptoms	14.13%	42.93%	<0.0001
g. Re-infectivity	18.40%	56.80%	<0.0001

Appendix 1: Teacher knowledge questionnaire

Teacher Knowledge Questionnaire

Participant Number: ____ Compound (optional): _____

1. Rank the following water sources (1-5) based on cleanest being a 1 and dirtiest being a 5?
   Bore hole
   Water from a community tap
   Protected dug well
   Unprotected dug well
   Body of water (stream/river/pond/lake)

2. How does washing your hands prevent disease?
   A. It gets rid of germs so that they don't seep into your skin.
   B. It gets rid of germs so that they aren't eventually ingested via the mouth.
   C. It gets rid of dirt so that particles aren't accidently inhaled.

3. When should one wash his or her hands (please circle yes or no):

-After defecation:	yes	no
-After taking a bath:	yes	no
-Before eating:	yes	no
-Before handling food:	yes	no
-Before playing outside:	yes	no

4. How does water become contaminated/dirty/unhealthy?

_____
_____
_____
_____
_____

5. Rank the following sanitation facilities (1-4) based on 1 being the best and 4 being the worst means of getting rid of waste:
   Traditional pit/latrine
   Ventilated improved pit/latrine
   Bush/field
   Pond/river/stream

6. Are waterborne diseases a major problem (please circle)? yes no

   Please circle any waterborne diseases from the list below:

-Bilharzia	-Asthma	-Typhoid Fever
-Cholera	-Tuberculosis	-Measles

7. Which of the following is TRUE about Bilharzia (circle all that apply)?

A. children are highly susceptible
B. it is a parasitic disease
C. snails play a role in disease spreading
D. it is a bacterial infection
E. water contaminated with human waste plays a role
F. it is spread by mosquitoes
G. the disease in treatable with simple medication
H. always has clear, identifiable signs and symptoms

8. What are some of the signs and symptoms associated with Bilharzia?

Appendix 2: Post-training teacher satisfaction survey

Post-Training/Pre-Lesson Plan Implementation Teacher Questions:

Participant Number: _____

1. What aspects of the training workshop did you find most useful?

_____

_____

_____

_____

2. What aspects of the training workshop did you find least helpful?

_____

_____

_____

_____

3. What aspects of the training workshop did you find difficult to understand?

_____

_____

_____

_____

4. What aspects would you like to learn more about?

_____

_____

_____

_____

5. How do you feel about the lesson plans discussed? Do you feel they will make a difference for the kids?

_____

_____

_____

_____

6. What questions do you have regarding the covered material?

_____

_____

_____

_____

7. What suggestions do you have regarding the overall structure of the training workshop?

_____

_____

_____

_____

8. Suggestions for the future or any further comments?

_____

_____

_____

_____

Appendix 3: Post-implementation teacher satisfaction survey

Post-Action Plan Implementation Teacher Questions:

Participant Number: _____

1. How do you think the kids liked the action plans?

_____

_____

_____

_____

2. What aspects of the action plans were difficult to carry-out in the classroom setting?

_____

_____

_____

_____

3. What aspects of the action plans did the students have difficulty understanding?

_____

_____

_____

_____

4. While implementing the action plans did you run into questions from the students? Did you encounter questions you didn't know the answers to?

_____

_____

_____

_____

5. Do you feel like the action plans actually help spread the health information to your students? How so?

_____

_____

_____

_____

6. Do you have any suggestions for improving upon the action plans? Is there a better way to spread the health information to your students?

_____

_____

_____

_____

7. Any further comments or suggestions?

_____

_____

_____

_____

Appendix 4: Student knowledge questionnaire

Student Knowledge Questionnaire

ID Number: _____

HP1. Given the following list, which is the dirtiest source of water (please circle one option only)? HP1. _____

1. Bore hole (associated with a pump)
2. Water from a community tap
3. Well (associated with a bucket)
4. Body of water (stream/river/pond/lake)

HP2. How does washing your hands prevent disease (please circle one option only)? HP2. _____

1. It gets rid of germs so that they don't seep into your skin.
2. It gets rid of germs so that they aren't eventually ingested via the mouth.
3. It gets rid of dirt so that particles aren't accidently inhaled.

HP3. When should you wash your hands (please circle yes or no):

HP3a.-After defecation:	1. yes	0. no	HP3a._____
HP3b.-After taking a bath:	1. yes	0. no	HP3b._____
HP3c.-Before eating:	1. yes	0. no	HP3c._____
HP3d.-Before handling food:	1. yes	0. no	HP3d._____
HP3e.-Before playing outside:	1. yes	0. no	HP3e. _____

HP4. Given the following list, which is the worst means of getting rid of waste (please circle one option only)? HP4. _____

1. Pit latrine
2. Bush/field
3. Pond/river/stream
4. Flush toilet

HP5. Is the following TRUE about Bilharzia (circle all that apply)?

HP5a. it is a waterborne disease	1. yes	0. no	HP5a. ____
HP5b. children are highly susceptible	1. yes	0. no	HP5b. ____
HP5c. snails play a role in disease spreading	1. yes	0. no	HP5c. ____
HP5d. water contaminated with human waste plays a role	1. yes	0. no	HP5d. ____
HP5e. the disease is easily treatable with medication	1. yes	0. no	HP5e. ____
HP5f. always has clear, identifiable signs and symptoms	1. yes	0. no	HP5f. ____
HP5g. if you have been treated for . Bilharzia once, you can not get it again	1. yes	0. no	HP5g. ____

Appendix 5: Toolkit Contents

Lesson 1. Water Sanitation→Handwashing
- Background Information
- Lesson Plan
- Suggestion for student assessment

Lesson 2. Waste Management→Human Waste Disposal
- Background Information
- Lesson Plan
- Suggestion for student assessment

Lesson 3. Bilharzia/Schistosomiasis
- Background Information
- Lesson Plan
- Suggestion for student assessment

Lesson 1. Water Sanitation→Handwashing

Background Information

As human beings we use our hands and fingers for various activities. Consider your typical day. Think about all of the surfaces, objects, and people your hands come in contact with. Can you count them? Are there too many to count?

As a result of the fact that we rely so much on our hands to complete everyday activities, they are often prone to the collection of dirt, uncleanliness, and germs. Our hands may be covered in germs even if they do not appear dirty. These germs can predispose people to disease.

To limit the risk of disease, we must be careful that the germs present on our hands do not enter the mouth or the eyes. **Properly washing hands with soap helps eliminate germs and maintain good health.**

❖ Why is proper handwashing so important?
- It removes germs from hands.
- It helps prevent disease transmission.
- It keeps hands clean.
- It removes odors/smells from hands.

❖ What is the proper method for handwashing?
- The water must be clean and running/pouring. Note, if the water is sitting in a basin or container and has been previously touched, then it is no longer clean.
- Use soap whenever possible.
- Scrub thoroughly for at least 20 seconds (singing the ABCD song takes about 20 seconds).
- Do not forget to clean under the nails.
- Air-dry hands when finished.

* Refer to the image below for a visual of proper technique. *

Proper Hand washing Technique

❖ When is handwashing absolutely necessary for good health?
- After visiting the toilet.
- Before eating food.
- Before touching food.
- Before handling safe water containers.
- After touching or playing with animals.
- Whenever hands look dirty.

❖ **Key Summary Points**
- Hands and fingers are prone to collecting germs and becoming dirty.
- Hands may be covered in germs even when they do not look dirty.
- To remove germs and prevent disease, proper handwashing with soap must be promoted.
- Proper handwashing involves running water, soap, scrubbing for 20 seconds, and air drying.
- While it is good to wash hands often, there are certain times where it is essential for good health.
- Handwashing must be promoted before touching food and after using the toilet.

Lesson 1. Water Sanitation→Handwashing
Lesson Plan

Subject: Water Sanitation—Handwashing

Objectives:
- Students will begin to understand what germs are.
- Students will understand why handwashing is important.
- Students will know when to wash their hands.
- Students will practice how to properly wash their hands.

Materials:
- Soap
- Running water
- Baby Powder or Chalk Dust Powder
- Teacher Aid #1: Poster depicting when to wash
- Teacher Aid #2: Poster depicting how to wash

Procedure:
PART 1
1. Opening question: Ask the students, "Has anyone heard of the word "germs" before? Can anyone explain what germs are?
2. Encourage and allow students to offer answers.
3. Comment on student answers and explain that germs are tiny invisible bugs that get into the body through the mouth and eyes and cause disease (poor health).
4. Emphasize that germs are tricky because they are so tiny that they cannot be seen with the eyes.
5. State that you will now begin an activity to explain how germs (these tiny invisible disease-causing bugs) are spread.
6. Activity: rub a small amount of powder on the hands of each student. Allow the students to have 5-10 minutes of "free time," allowing them to move about the classroom.
7. After the free time has passed, regain the attention of the students.
8. State "We are using this white powder as an example of the germs that are on our hands but we cannot see."
9. Ask "Looking around the room, can anyone tell me where the powder has spread?" Answers may include (faces, arms, etc.), books, desks, papers.
10. Discuss the following:
    -How many of you touched this desk?

-How many people were in this desk before you?
-If one person is sick and has germs on their hands and then he touches you or your things, what can happen? (Answer: the germs spread!)
-How often do you put your hands near your mouth or eyes?

11. Summarize for the students: "Germs are tiny invisible bugs that causes disease. They are spread by the hands and touching people and objects. When we touch our mouths or eyes we spread the germs into our bodies."

PART 2

1. Opening question: Ask the students, "Does anyone know how we can get rid of the germs on our hands?"
2. Encourage and allow students to offer answers.
3. Comment on student answers and explain that the best way to get rid of germs is to wash our hands.
4. Emphasize that we wash our hands to get rid of the germs so that they don't enter our mouths or eyes.
5. Ask "When is it most important to wash our hands?"
6. Encourage and allow students to offer answers.
7. Use Teaching Aid #1 to review when they should wash their hands: after using the latrine, before touching food, after playing with animals, whenever they look dirty.

PART 3

1. Opening question: Ask the students, "Can anyone tell me what is needed for proper handwashing?"
2. Encourage and allow students to offer answers.
3. Comment on student answers and explain that there are 3 things we need to wash our hands properly: 1. running water, 2. soap, and 3. time.
4. Use Teaching Aid #2 to review how to properly wash hands.
5. Ask "How long do we have to scrub our hands for?"
6. Allow students to guess. State "we should wash our hands for 20 seconds". Note that this is about how long it takes to sing the ABCD song. What a nice way to practice the alphabet!
7. Activity: Ask two students to come to the front of the class to demonstrate how to wash their hands properly. Have them sing while pretending to scrub with water and soap.
8. Ask the class "Did these students wash their hands properly? What did they do well? Did they do anything wrong?"
9. Have the students repeat the proper technique at their desks while singing the ABCD song.

10. Ask “Once we have washed our hands they are all wet. What is the best way to dry them?”
11. Encourage student answers. If someone says to rub them on clothing, explain that the germs on clothing are then transferred back to our hands.
12. Answer “The best way to dry our hands after proper washing is to air-dry them. This is done by waving our hands in the air until all the water dries up or falls off.”
13. Give the students a break at this time. Encourage the students to go outside and properly wash their hands to remove any remaining powder or any germs.

Student Assessment Suggestion:
‘Performance’ can be used as a valid means of student assessment in this case.

Having excused the students to take a break, observe each student as he washes his hands. Mark if soap is used. Mark the duration of scrubbing. Mark if hands are allowed to air dry.

Give feedback to each student on their handwashing technique and how they can possibly improve.

Lesson 2. Waste Management→Human Waste Disposal

Background Information

Human waste (urine and stool) is a possible source of disease.

In some Zambian communities, people still use the bush or stream to pass urine and stool. This can lead to outbreaks of common diarrheal diseases and bilharzia.

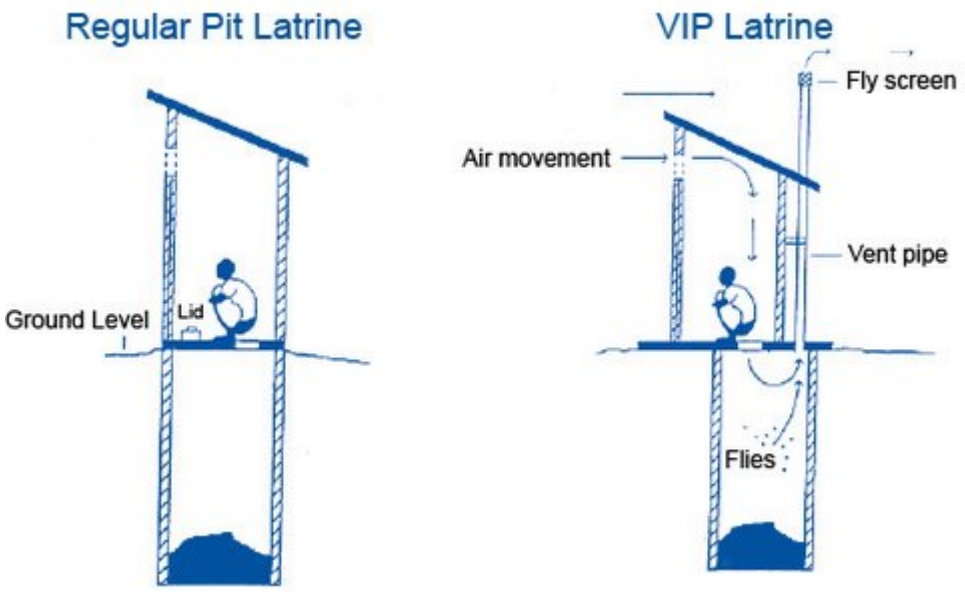
Households must be encouraged to build, use, and maintain clean latrines/toilets. All children, even young children, should be encouraged to use latrines.

- Where should people pass urine or stool?
  - Traditional Pit Latrines
  - Ventilated Improved Pit Latrines (VIP)
  - Flush Toilets

- Where should people **never** pass urine or stool?
  - Bush or Field
  - Any body of water (stream, river, pond, lake)

- What are the advantages of using a latrine or flush toilet?
  - They help prevent diarrheal disease and bilharzia outbreaks.
  - They keep flies, insects, and pests away.
  - They provide privacy.
  - They protect the user from the environment (rain, wind, etc.)

- What is the difference between a traditional pit latrine and a VIP latrine?
  * Please refer to the following image *



- The main difference between a traditional pit latrine (left) and a VIP latrine (right) is that the VIP latrine has a vent that includes a fly screen.
- The VIP fly screen keeps the flies trapped in the pit and vent. Since the flies cannot escape, they eventually die. This prevents the flies from spreading disease.
- The VIP vent also reduces or eliminates smells. As the diagram shows, there is better air movement.
- Overall, a VIP latrine is better than a traditional pit latrine because it helps limit flies and better eliminates bad smells.
- Both types of latrines can be constructed from local, cheap, and available material.

❖ What is unique about flush toilets?

- The flush toilet is the best method for managing urine and stool.
- The flush toilet is comfortable and odor free.
- Disadvantages: it is significantly more expensive, requires large quantities of water at all times, and needs regular maintenance.

❖ **Key Summary Points**

- The improper disposal of human waste (urine or stool) leads to common diarrheal diseases and bilharzia.

- No one should use the bush, filed, stream, or lake to pass urine or stool.
- Everyone, including young children, should be encouraged to use either a latrine or a toilet.
- VIP latrines are better than traditional pit latrines because they include vents and a fly screen. The vent reduces odor and the fly screen reduces flies.
- Latrines can be easily constructed with local items.

Lesson 2. Waste Management→Human Waste Disposal
Lesson Plan

Subject: Waste Management—Human Waste Disposal

Objectives:

-Students will know never to pass stool or urine in a bush or field.
-Students will understand why it is important to use a latrine/toilet.
-Students will practice encouraging others to use and maintain clean latrines.

Materials:

- 1 set of erasable markers
- Several sheets of regular sized paper
- Pencils or pens
- Teaching Aid#3: Semi-blank laminated poster paper (alternatively, a regular chalk board can be employed)

Procedure:

PART 1

1. Opening question: "Students if you have the option of passing stool in a field or in a latrine, which is better?"
2. Hopefully most students will say latrine. If others say a field, note "how interesting, it seems we have different opinions in the class. Let us review why it is better to use a latrine."
3. Ask, "For those who said latrine, can you share why it is better to use a latrine than to pass urine or stool in a field?"
4. Encourage and allow students to share their answers.
5. Review that latrines are better in several ways:
    - They provide privacy.
    - They protect us from the outside environment (rain, wind, etc)
    - Because the urine and stool is not sitting outside, they help keep away pests and flies.
6. Tell the students that you would like to share some new information with them. Remind them of your previous discussion of germs. Have a student define what the word "germ" means. Then say, "Students, did you know that our urine and stool also has germs in it?!"
7. Allow the students to react.

8. State, “We discussed previously how tricky germs are and how they can spread. Remember the powder? Well, now we know that there are germs in our stool and urine as well.”
9. Ask, “So if someone passes stool or urine outside (not in a latrine) and you step in it or accidentally touch it, what happens to the germs in the stool or urine?”
10. Encourage and allow students to share their answers. Correct answer: the germs spread!
11. Conclude, “So we can see that using latrines is also very important because they help keep germs from spreading!”

PART 2
1. Tell the students that you want to take them outside to look at the school’s latrine.
2. At the latrines, asks the students to pay attention to what they see, what they smell, and how they feel.
3. Return to the classroom.
4. Ask, “We went out to look at our school’s latrine. What did you all notice?”
5. Allow for an open discussion. Some may note the level of cleanliness. Others may note an odor.
6. Bring out Teaching Aid #3. State, “We have looked at our latrine and seen good things and bad things. Let us make a list. On the left, we will note the qualities that make a latrine a good latrine (one we feel comfortable using all the time). On the right, we will note the qualities that make a latrine a bad latrine (one we might try to avoid).
7. Use Teaching Aid #3 to compose the list based on student responses. Remember to loudly repeat the student answers, as the list will mainly help students that are able to read.
8. State, “Very good students. We now have a list of qualities that make a good latrine and a bad latrine. Notice that our latrine has some qualities that come from both sides of the list.”
9. Ask, “Since we all share our latrine, we are all responsible for maintaining it. What can we each do to make sure our latrine is a good larine?” Answers will vary but will likely include helping younger children, being careful to aim properly, alerting the teacher if there is something wrong.

PART 3
1. Summarize what has been covered so far. “We have discussed why it is important to use latrines and how latrines help us stop germs from spreading. We should always avoid passing urine or stool in a field/bush. We have also

come up with a list together of what makes good/bad latrines. Finally we have talked about how we can better maintain our own latrine to make it better."
2. Activity: Ask the class to break up into small groups (5-8 students each). Provide each group with a sheet of paper and a writing instrument. Make sure that each group includes a student that can read and write.
3. Explain to the students that you want them to work together to write a letter to a friend in another compound. In this letter you want to promote the use of latrines, explaining why they are so useful. Also have them make clear why it is bad to pass urine or stool in a field or bush. Encourage them to tell their friend how to maintain a good latrine.
4. Provide the students 15 minutes to discuss among themselves and create their letters. Rotate among the groups to answer questions and make sure that the task is being completed correctly.

Student Assessment Suggestion:
'Product,' in the form of a writing assignment, can be used as a valid means of student assessment in this case.

Collect the letters at the end of the activity and note which students were involved in each group. Evaluate the letters for accuracy of information. Make sure that the learning objectives of the lesson are clear based on what the students have written in their letters.

Give feedback to the groups if any information is incorrect or missing from the letters.

Lesson 3. Bilharzia/Schistosomiasis

Background Information

Bilharzia is a water-related disease caused by worms that live in bodies of water (streams, rivers, ponds, lakes).

Bilharzia is a very common disease among children because they often play, swim, and wash in bodies of water. By touching the infected water, children are exposed to the bilharzia worm.

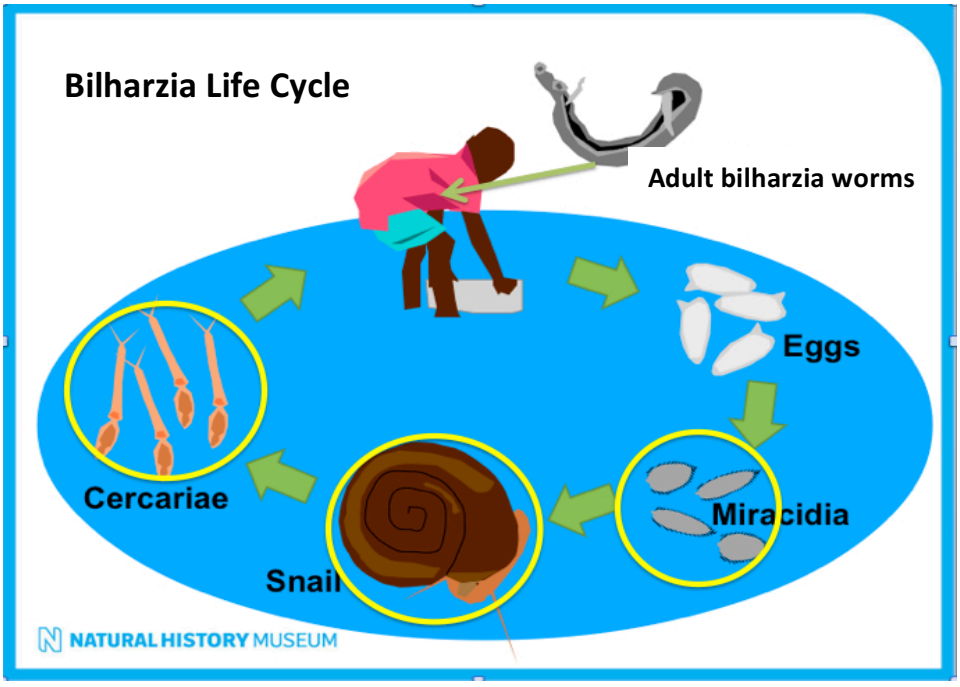
Sadly, many infected students live with bilharzia for a long time and never visit health facilities. As a result, many children suffer from poor health. It is important to know that bilharzia can be both easily cured and easily prevented.

❖ What is Bilharzia?

- Bilharzia is a disease caused by a special worm that lives in bodies of water, like the streams around N'gombe. The disease can affect the urinary system and the intestinal system. The urinary type is more common in Zambia.

❖ How do people get Bilharzia?

* Please refer to the following image *



- **Bilharzia is a disease that is spread through water in a cyclic (like a circle) pattern.**
- It is important to know that the bilharzia worm can live in 3 forms: the adult form, the miracidia form, and the cercariae form.
- The adult form of the bilharzia worm lives inside infected people. The adult worms lay eggs that are hiding in human urine and/or stool. If an infected person passes urine or stool into a body of water, the eggs are transferred into the water.
- In the water, the eggs hatch and the miracidia form of the bilharzia worm comes out.
- The miracidia form of the bilharzia worm can infect certain types of snails living in bodies of water.
- The worm grows in the snail and comes out of the snail in the cercariae form.
- The cercariae form of the bilharzia worm lives in the water until it notices a human. The cercariae form of the bilharzia worm infects human by going through the skin.

❖ How is the bilharzia worm so tricky?

- **The bilharzia worm is very very tiny. It cannot be seen in the water without the use of a microscope**. The eggs also cannot be seen in the urine or stool without a microscope.
- When the bilharzia worm (cercariae form) goes through human skin, it may cause no pain at all! Because it is so very small, there is no mark or scratch!

❖ What are the signs of symptoms of bilharzia infection?

- Pale skin (anemia)
- Painless blood in urine
- Malnutrition
- Belly pain
- Body hotness (fever)
- Generalized body weakness
- Again, bilharzia is very tricky: sometimes there are no obvious or specific signs or symptoms!

❖ What are some serious complications of bilharzia infection?
- Stunted growth
- Delayed cognitive development (mental slowing)
- Infertility
- Bladder Cancer
- Death

❖ Who can get bilharzia?
- Anyone can be infected.
- **Young children are most at risk because they often play in bodies of water.**

❖ What is the treatment for bilharzia?
- A medicine called Praziquantel can cure bilharzia.
- Just need one pill.
- There are no major side effects.
- If a cured person touches water where the bilharzia worm lives, they can still become reinfected.

❖ Why is **prevention of bilharzia so important**?
- Sometimes it is hard to recognize a person infected with bilharizia. The infection may last a long time and damage the inside of the body with no outside signs. It is thus better to prevent infection than to get sick and eventually receive treatment.
- Prevention is less expensive than treatment.

❖ How can bilharzia be prevented?
- The bilharzia worm is very tricky. Because it is so very very small, it is unclear which bodies of water the bilharzia worm lives in.
- It is best to avoid walking, swimming, or washing in bodies of water (streams, rivers, ponds, lakes).
- To stop the cycle it is also important to avoid passing urine or stool into bodies of water. Using latrines is important for good health.

❖ **Key Summary Points**

- Bilharzia is a disease caused by tiny worms that live in bodies of water.
- People become infected with the bilharzia worm when they touch the water where the worm lives.
- The bilharzia worm is tricky because it cannot be seen without a microscope and leaves no mark when it enters human skin.
- Although bilharzia can be treated with Praziquantel, it is much better to promote prevention.
- Children are at high risk of bilharzia infection and should be advised to avoid walking, washing, or swimming in bodies of water.

Lesson 3. Bilharzia/Schistosomiasis

Lesson Plan

*Subject:*Bilharzia

Objectives:

- Students will understand the basics of bilharzia (a disease caused by tiny worms that live in bodies of water).
- Students will know never to pass stool or urine into a body of water (stream, river, pond, lake).
- Students will know to avoid walking, washing, or swimming in bodies of water.

Materials:

- Teaching Aid #4: Poster depicting how bilharzia is spread
- Teaching Aid #5: Martha's Story (6 laminated strips-each recording part of Martha's story)
- 3 boxes of crayons

Procedure:

PART 1

1. Opening question: "Students can anyone remind me what germs are?"
2. Encourage and allow students to offer answers.
3. Repeat the correct answer, "Germs are tiny invisible bugs that cause disease."
4. Provide an introduction to the new subject, "Today I want to tell you about a special germ. This germ (invisible bug) is a tiny tiny worm called the bilharzia worm. It causes a disease caused bilharzia."
5. Have the students repeat the word "bilharzia" to ensure proper pronunciation.
6. Bring out Teaching Aid #4. State, "We are going to use this picture to show where the bilharzia worm comes from and how it is spread."
7. Allow the students to collectively view Teaching Aid #4.
8. Ask, "What do you see? What is happening in this picture?" Answers may include noticing the body of water, someone passing stool, women washing clothing, etc.
9. Specifically point out the two children that are shown passing stool and urine.
10. Remind the students that germs are also found mixed into stool and urine.
11. Proceed to a basic explanation of bilharzia transmission: "Students look at the two children passing urine and stool by the water. These children are sick with bilharzia. This means that the bilharzia worm is mixed in their stool and urine.

When they pass stool or urine into the water, the bilharzia worm is spread into the water!"
12. Ask, "Can anyone tell me who else is in the water?" Possible answers: Boy swimming, women washing, etc.
13. Repeat, "Good. We see all of these people touching the water with bilharzia worms."
14. State clearly, "Now the bilharzia worm is trickier than most other germs. Like other germs it is invisible. AND it is also able to get into our bodies by going through our skin!! When we touch the water, the bilharzia worm goes through the skin without causing any pain or leaving a mark."
15. Repeat the transmission information. Again noting the connection between 1. an infected person urinating/passing stool near or in the water → 2. the bilharzia worm spreading to the water → 3. previously healthy people touching the water → 4. the bilharzia worm moving through the water and going through people's skin → 5. the people now being sick with bilharzia disease.
16. Ask the students if they have any questions. Use the Lesson 3 Background Information to answer any remaining questions.

PART 2
1. Ask, "If these people had NOT passed urine or stool into the water, what would be different?"
2. Encourage an older student to recognize that without the bilharzia worm passing from an infected person into the water, the other people would not be at risk of infection. (This establishes a cause and effect relationship.)
3. Emphasize, "We learned previously that we should never pass urine or stool in a field. Now we see that we should never pass urine or stool in or near water. We do not want the germs in our urine or stool mixing into the water and spreading to others. We must use latrines."
4. Ask, "I have another question. If the other 'healthy' people were not touching the water that the bilharzia worm lives in, what would be different?"
5. Encourage an older student to recognize that if the people were not touching the water, they would not be at risk of infection. The bilharzia worm would not be able to get to them without the water connection. (This establishes a second cause and effect relationship.)
6. Explain, "We have identified two ways we can help stop bilharzia infection. 1. We must avoid passing urine or stool near water. 2. We must avoid touching, walking, swimming, and washing in stream water."

PART 3

1. Inform the students that you will be staying on the same topic, but that you now want to tell them a story.
2. Use Teaching Aid #5 to read through the story of Martha.
3. Activity: Have the students divide themselves into 6 groups. Give each group a segment of Martha's story (one of the laminated story strips).
4. Inform the students that each laminated strip is part of the story. You have the words of the story noted down but need help with the pictures. Provide a piece of paper and crayons to each group. Go to each group and directly tell them what part of the story they are being asked to illustrate.
5. Give the students 15-20 minutes to work on their drawings.
6. Visit each group and ensure they understand they are being asked to depict.
7. Select one member from each group to bring up their picture to the front of the class.
8. Place the students in the correct story order and have them explain their drawing and what is happening to Martha.
9. Congratulate the students on helping you show Martha's story. Note that you will now have this book that everyone made together to keep for the class.

PART 4

1. Acknowledge that you have covered a lot of new material in this lesson.
2. Ask the students if they have any questions.
3. Explain that you want the students help reviewing all the information.
4. Ask, "Who can tell me one thing we learned today about bilharzia?"
5. Go around the room and allow each willing student to state a fact about bilharzia.
5. Make sure the following is reviewed:
    - Bilharzia is a disease caused by a tiny worm.
    - The bilharzia worm is invisible.
    - The bilharzia worm is spread by the stool or urine of infected people passes into water.
    - We should avoid passing stool or urine into or near water.
    - The bilharzia worm moves from the water through the skin of anyone touching the water, causing infection.
    - The bilharzia worm doesn't cause any pain when it goes through the skin.
    - The bilharzia worm doesn't leave a mark when it goes through the skin.
    - We should avoid touching, walking, swimming, and washing in bodies of water.
    - Bilharzia disease can cause pale skin, painless blood in urine, belly pain, body hotness, and general weakness.

- Bilharzia disease can be treated with medicine.

Student Assessment Suggestion:
'Class participation' can be used as a valid means of student assessment in this case.

This lesson provides many opportunities for the students to express their knowledge by answering questions. The review session in particular provides an open forum.

Teaching Aid #5: Martha's Story

1.
Martha is a 7 year old girl in Ms. Carol's class. She loves the color blue and her favorite subject in school is mathematics. She likes going to school to learn and to see all of her friends.

2.
Martha lives at home with her mom, dad, and 2 brothers. Their home is right by a stream. There is a small bridge people use to cross the stream. But sometimes Martha decides to walk through the water.

3.
One morning Martha woke up for class but was not feeling well. She had body hotness and belly pain. When she went to pass urine in the latrine, she noticed that her urine was bloody!

4.
Ms. Carol noticed that Martha was missing from class that day. At the end of the day, she went to Martha's home, crossing the bridge over the stream. Martha was in bed and told Ms. Carol about the bloody urine, belly pain, and body hotness. Ms. Carol knew that the tricky bilharzia worm live in streams and can cause sickness. She took Martha to the local clinic.

5.
At the local clinic, they met Dr. Patrick. Dr. Patrick gave Martha medicine to kill the bilharzia worm inside her and make her better. He explained that the tricky bilharzia worm can move from water into our skin, without leaving a mark, and cause us to feel unwell.

6.
After taking the medicine, Martha started to feel better and better. She was able to return back to school and to see all of her friends. She decided that she didn't want to get sick again. She would use the bridge to cross the stream from now on.