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# Theory-driven formative research on on-site, shared sanitation quality improvement among landlords and tenants in peri-urban Lusaka, Zambia

James B. Tidwell<sup>a</sup>, Jenala Chipungu<sup>b</sup>, Roma Chilengi<sup>b</sup>, Valerie Curtis<sup>a</sup> and Robert Aunger<sup>a</sup>

<sup>a</sup>Department of Disease Control, London School of Hygiene & Tropical Medicine, London, UK; <sup>b</sup>Center for Infectious Disease Research in Zambia, Lusaka, Zambia

## ABSTRACT

Rapid, unplanned urbanization in low-income countries is leading to increasing problems of dealing with human waste. On-site sanitation systems are often rudimentary, unhygienic, and poorly maintained. In-depth, on-site interactive interviews were conducted with 33 landlords and 33 tenants in a neighborhood in peri-urban Lusaka to understand on-site, shared sanitation quality improvement behaviors and preferences. Respondents were asked about housing characteristics, toilet histories, and financial decision-making. Improved, shared toilets were common (79%), but many were of low quality and poorly cleaned. Poor coordination among tenants, barriers to communication between landlords and tenants, and landlords viewing sanitation as a required basic service to provide instead of something for which tenants will pay more rent all limit the quality of sanitation in this setting. Landlord-directed interventions targeting non-health motivations for sanitation improvement and introducing effective cleaning systems may increase peri-urban sanitation quality.

## ARTICLE HISTORY

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## KEYWORDS

Zambia; peri-urban; sanitation; behavior change; Behavior-Centered Design; intervention development

## Introduction

### Background

The provision of safe and affordable sanitation is a growing challenge in rapidly urbanizing low- and middle-income countries. In 2014, about 890 million people lived in unplanned peri-urban areas (PUAs) globally (Habitat 2013), with ‘inadequate access to safe water, inadequate access to sanitation and other infrastructure, poor structural quality of housing, overcrowding, and insecure residential status’ (UN-HABITAT 2003). The number of people living in such conditions is estimated to more than double to about 2 billion by 2030 (UN-HABITAT 2003). Unsafe sanitation is the second leading risk factor for disability-adjusted life years lost due to diarrheal disease globally (Collaborators GDD 2017). Furthermore, people living in PUAs experience worse health outcomes than those in rural or other urban areas (Ezeh et al. 2017). To meet Sustainable Development Goal 6.2, ‘safely managed sanitation for all by 2030’ (WHO and UNICEF 2015), the problem of inadequate sanitation in PUAs must be solved.

In PUAs where open defecation is rare and most have access to a toilet, shared toilets of poor quality are common (Bank, 2015). Evidence suggests that as the number of users of a toilet increases, the structural quality may increase (Jenkins et al. 2014), but cleanliness decreases (Günther et al. 2012; Heijnen et al. 2014; Exley et al. 2015), which is a public health concern

**CONTACT** James B. Tidwell  ben.tidwell@lshtm.ac.uk  London School of Hygiene & Tropical Medicine, Keppel St, London WC1E 7HT, UK

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(Tumwebaze and Mosler 2014). The UNICEF/WHO Joint Monitoring Programme currently categorizes sanitation quality using a ladder with five rungs (from lowest to highest quality): *open defecation*, *unimproved* sanitation (which doesn't separate excreta from human contact), *limited* sanitation (which does separate excreta from human contact, but is shared by more than one household), *basic* sanitation (separates excreta from human contact and used by only one household), and *safely managed* sanitation, which additionally treats or manages human excreta (WHO and UNICEF 2015). There have been recent gains in the prevalence of basic sanitation globally, but sub-Saharan Africa has lagged behind (UNICEF and WHO 2015). There, the number and proportion of people using unimproved or limited (shared) sanitation increased from 204 million (40%) in 1990 to 465 million (47%) in 2015 (UNICEF and WHO 2015).

Attempts to improve sanitation globally have included outright provision, subsidies, regulation, and promotion. Providing improved toilets and sewage systems is costly (Hutton and Varughese 2016) and often impractical, and delivering subsidies to reduce the costs of provision has been challenging (Evans et al. 2009). Local government institutions in PUAs are often ineffective in enforcing regulations, and heavy-handed enforcement may simply displace residents to less regulated settlements (McGranahan 2015). Promotion has been successful in some rural settings (Venkataramanan et al. 2018), where the most common intervention, Community-led Total Sanitation (CLTS) brings together communities and motivates latrine construction through triggering disgust, facilitating group commitment, and triggering self-monitoring. However, there is a lack of comparable evidence in urban settings (Schmidt 2014). Some successful interventions in similar contexts have led to community coproduction of low-capacity sewage (Hasan 2006) or public toilets shared by larger numbers of people (Burra et al. 2003) as well as improvements in cleanliness (Tumwebaze and Mosler 2015; Alam et al. 2017), but none have examined the processes by which toilet quality is improved.

One approach that has been widely advocated is Sanitation Marketing (Bank 2004; Devine and Kullmann 2011). This aims to stimulate both the supply of, and the demand for, sanitation products and services. However, despite many gray literature reports, no peer-reviewed studies have evaluated its effectiveness (Evans et al. 2014; Schmidt 2014). We hypothesized that it might be possible to improve the quality of sanitation by improving consumer demand alone, without improving supply, in a PUA. Such a program could be relatively cheap and might be feasible to scale in similar areas globally. With the idea of designing an intervention that could be tested in a trial, we carried out Formative Research on consumer behavior with respect to sanitation in a peri-urban settlement in Lusaka, Zambia.

The intervention was designed using Behavior-Centered Design (BCD). BCD classifies the determinants of behavior as they relate to an individual's reactive, motivated, and executive brain; to their body; and to the social, physical, and biological environment in which behavior takes place. It further uses the concept of 'behavior settings' to characterize the environmental and psychological determinants of behavior in their context (Barker 1955). Components of behavior settings include routines, roles, scripts, norms, and competencies as well as stage, infrastructure, and props. BCD formative research process makes use of a checklist of behavioral determinants that the design team progressively refine as they learn about target behaviors. Using an explicit behavior change theory to drive formative research ensures that a comprehensive set of potential behavioral determinants, target actors and behaviors, and pathways to change are investigated, some of which might otherwise be missed by general qualitative approaches (Simiyu et al. 2017).

This paper reports the results of a formative research study that was designed to examine how toilets can be improved in a PUA of Lusaka, Zambia. The main objectives were to understand the existing state of sanitation, the process by which sanitation quality is maintained and improved, the roles of landlords and tenants in those processes, and the main drivers of quality maintenance and improvement.

## Methods

### Context

Bauleni is a PUA in southeast Lusaka with a population of about 64,000 (Ministry of Local Government and Housing 2014). It was chosen to be representative of PUAs in terms of age, density, and demographics and the lack of any recent or planned sanitation projects. Bauleni has no sewer lines, and so pit latrines or septic tank systems are the main forms of containment. Bauleni is subdivided into individually titled plots of about 100 m<sup>2</sup> in size which were originally intended to be occupied by one household. However, most plots have been subdivided to provide small units (or 'doors') which are rented out by the plot owner. We therefore interviewed both adult landlords and their tenants.

### Sampling

To achieve a sample representative of peri-urban slums in Lusaka, respondents were purposively selected from a large, prespecified area within Bauleni (to avoid contaminating the later trial). The sampling unit was the plot ( $n = 66$ ). From each selected plot, we randomly surveyed either the landlord or a tenant from a randomly selected household. We ensured that males represented at least one-third of respondents in each category by only conducting interviews with males once the corresponding number of females for that category had been interviewed. If more than one toilet was present on a plot, we asked about the toilet used by the tenants most of the time.

### Data collection and analysis

We developed interactive semi-structured interview guides based on the literature review. A team of four research assistants were trained by five members of the research team and the group piloted and revised the guides over a 1-week period in PUAs outside of the planned intervention area. Members of the research team were paired with research assistants to collect data for 1 week, and then research assistants collected data in pairs over 3 more weeks in September 2016.

We employed a variety of quantitative, semiquantitative, and qualitative data collection tools that captured basic demographics, mapped plots, and social networks; captured the construction history and current status of toilets; ranked the most desired aspects and motives for making toilet improvements; and examined financial decision-making for improving the plot. The tools prioritized observation, forced choices, and retelling of experiences over questionnaire-based techniques. These are described in [Table 1](#). The local research assistants, who spoke Nyanja and Bemba, visited respondents' homes, recorded responses using paper forms, and entered the data into a Microsoft Excel spreadsheet. We aimed to complete all tools for each interview except when tenants were uneasy about discussing their financial decision-making or grew weary. Members of the study team verified data entry, and audio recordings were consulted when anything in the notes was unclear. We coded the qualitative responses, produced descriptive statistics based on response frequency and organized results using the BCD categories of behavioral determinants. We also used exploratory thematic analysis on the richer detail of the full qualitative data set to explain trends discovered in the quantitative summaries.

## Results

Results are categorized into topics relevant to the theory of change for the planned intervention. All are topic areas specific to the primary question of how to promote toilet improvements in a plot with landlords and tenants.

**Table 1.** Data collection tools.

Tools	Description	Sample size
Demographics	Respondents were asked their age, gender, occupation, level of education, literacy, and monthly rental fees.	66
Plot Maps	Research assistants drew maps of the plot. Respondents were asked if the landlord lived on the plot; the number, composition, and tenure of households; and types of relationships between households.	65
Social Network Analysis	Names of people "most important to you now," "somewhat important to you," and "a little important to you" were placed into three concentric circles by research assistants. Respondents were prompted to identify who they had (1) borrowed money from, (2) lent money to, (3) had assistance from in a medical emergency, (4) given advice to, (5) talked to regularly, (6) had parenting advice from, and (7) asked or would ask for help if their toilet broke (Devine and Kullmann 2011).	20 <sup>a</sup>
Toilet Histories	Respondents were asked about the process of building the toilet, changes made since initial completion, how it was cleaned, if there had been any challenges in accessing the toilet, and for what things the facility was used.	65
Toilet Observations	Research assistants assessed toilet quality by direct observation of components such as a roof or solid door. A few items, such as the type of pit lining, were obtained by respondent report.	63
Improvement Preferences	Respondents ranked 14 toilet components pairwise on cards from most to least important and discussed why choices were made.	56
Improvement Motives	Respondents ranked cards depicting the motives of Disgust, Create, Affiliate, Nurture, Love, and Status for their top improvement choice. Respondents were asked to rank and explain their top three motives.	59
Financial Decision-Making	Respondents were asked about large purchases they had made, how they saved money for them, general savings practices, previous use of financial services (bank accounts, loans, informal sources), and who they consulted about financial decisions.	55

<sup>a</sup>Terminated prematurely due to rapid information saturation.

**Table 2.** Sample characteristics.

Individual characteristics	Landlords ( <i>n</i> = 33)	Tenants ( <i>n</i> = 33)
Gender: male	33%	33%
Age (median)	39	28
Literacy rate	73%	82%
Years of education (mean)	7.6	8.7
Time since moving to plot (median)	17.5 years	1.4 years
Household size (mean)	4.5	3.7
<b>Plot characteristics (<i>n</i> = 66)</b>		
<b>Plot composition</b>	<b>Median (interquartile range)</b>	
Households per plot	4 (3–7)	
People per plot	15 (12–21)	
Monthly rent per tenant household	356 Kw [\$37] (250–450 Kw [\$26–47])	
Total monthly rent per plot	1170 Kw [\$123] (670–2250 Kw [\$71–237])	
Percent with resident landlord	77%	

### Sample characteristics

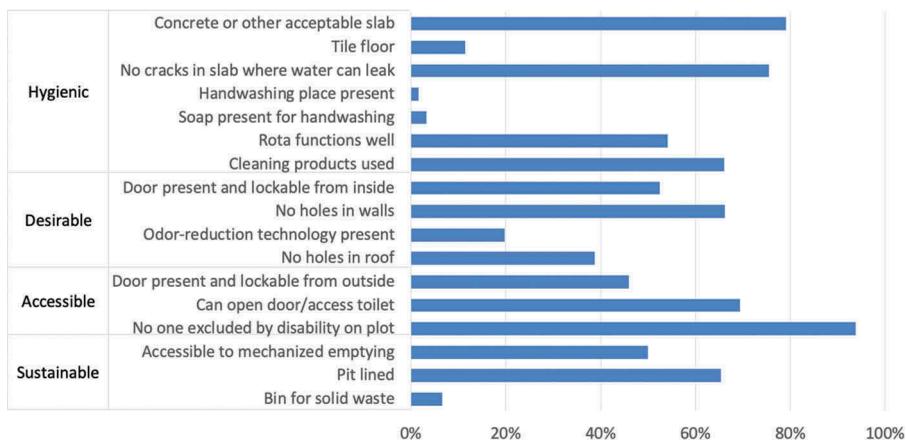
Table 2 shows the characteristics of the sample. Only five of the plots in the study had no tenants present, of which two were 'family plots,' where all resident households were kin. At least one other kin household lived on 21% of plots. Almost every plot had a functioning toilet, and the very few that had more than one had separate toilets for tenants and the landlord. Three quarters of plots had a landlord who was currently resident. Landlords (*n* = 33) were generally older than tenants (*n* = 33), had lived much longer on their current plot, and had larger household sizes. Tenants were more likely to report being able to read and write than landlords and had slightly more years of education. A typical plot had a median of 15 people (including children) residing on it at any given time.

## Toilet observations

Direct observation confirmed that most toilets would be defined as ‘limited sanitation’ by the SDG guidelines – technologically sufficient (mostly pits latrines with slabs), but shared by multiple households; however, [Figure 1](#) shows that there were large variations in the quality of the 63 toilets that were observed, with items grouped according to the ‘Peri-urban Healthy Toilet Index’ developed for this trial (Tidwell et al. 2018). Hygiene measures captured how well excreta was separated from human contact. Improved slabs were common (79%), but very few toilets had adequate handwashing facilities (3%). Desirability measures captured the experience of use, and toilets sometimes had a door that was lockable from the inside (53%) and well-constructed walls providing privacy (66%) or a roof protecting from the rainfall or direct sun (38%). But odor-reduction technologies were uncommon (20%), with the most frequently observed being ventilation pipes for VIP-style latrines. Accessibility captures how regular and equitable use of the latrine was. About half of plots had toilets that could be locked from the outside to prevent access by outsiders, while 31% had doors that couldn’t be opened immediately at the time of the observation – usually because a landlord with a key was away from the plot and had to be called back. Sustainability examines how likely the quality of the toilet is to continue into the future. Lined pits were reported for about two-thirds of toilets. Only about half of toilets were accessible to mechanized emptying due to challenges accessing the toilet (due to the layout of the plot or nearby roads) or accessing the pit (due to the toilet design). Well-functioning toilet cleaning rotas were present on 54% of plots. When toilets were not built to be emptied (either without a strong lining or a point of access), landlords generally reported that space to build a new toilet was not an issue and that they wanted to build an emptyable one in the future.

## Toilet histories

Most toilets (54%) had been built within the last 3 years, while some (15%) had lasted 10 years or more. Though some landlords started to build better quality toilets at times, construction was usually completed only when the previous toilet became unusable because it had filled up, became damaged, or collapsed. Most plots had enough space to build additional toilets, though landlords had little interest in moving toward individual household latrines and instead reported that they preferred to use spare land to build additional ‘doors’ rather than toilets. Many respondents



**Figure 1.** Detailed toilet quality breakdown.

Percentage of observed plots or respondent responses with given toilet component, grouped by Peri-Urban Healthy Toilet Index category (Evans et al. 2014).

reported that new toilets were constructed or finished in a hurry, being completed in a few days when necessary. One 35-year-old female tenant said,

The old toilet was very full, so we began to use one on another plot. The landlord had to look for money fast to build the toilet – maybe he took a loan. This was because the neighbors got upset that we were using their toilet in the night.

Toilets were usually built in stages by different individuals, ranging from professional masons to nearby family or household members with only general construction experience. Construction took anywhere from a few days to more than a year to complete, depending on the type of toilet to be constructed, weather conditions, availability of funds, and accessibility of temporary toilets constructed on the plot or nearby toilets on plots owned by the same landlord. Materials were purchased most often from markets in the city center, bought over time as funds allowed, and stockpiled on the plot or used to build incrementally as they were purchased. Temporary toilets, sometimes constructed for use until the permanent toilet is completed, consist of a simple hole with a superstructure made of stick and plastic tarpaulin or grass.

Landlords often reported the desire to have a better toilet in the future, but few had actually made any toilet improvements after construction was complete. Many toilets remained under construction for long periods, only being hastily finished when the need became urgent. A typical construction story was given by a young tenant on a family plot:

We started building a new toilet 2 years ago when the old one collapsed. The new one has two stalls – the first is just a pit, but the other will be fancier. Our neighbor, who is a bricklayer, built [the first] in four months. The other is under construction and is being used as a bathroom. We hope to connect a flush toilet inside with a septic tank in the second stall when the current one fills.

Landlords and tenants played different roles with respect to toilets building and maintenance. Landlords were in charge of planning changes and for paying for improvements to the structure. This included building new toilets or emptying existing ones when pits filled, and repairing damaged roofs, walls, or doors. Tenants sometimes provided labor in exchange for reduced rent payments, but didn't usually pay for improvements directly. The only cases where tenants expressed willingness to pay directly were for components not considered a part of the fixed structure, including exterior door locks and freestanding handwashing stands, though these were rarely observed. However, most tenants claimed to be willing to pay increased rent for better facilities. A few landlords had actually made such improvements and raised rental prices, but most landlords didn't believe that tenants would be willing to pay more. Some even stated that it was solely the landlord's responsibility to provide for his or her tenants, though only a basic toilet was seen as a 'human right,' and those aspiring to better toilets frequently claimed to be unable to make improvements due to a lack of funds.

### ***Toilet maintenance and use***

Toilet longevity varied greatly across plots, with some reported to have been in use for over 20 years, while others reported previous toilets collapsing or filling up and becoming unusable in just a few years due to variations in structural quality and pit emptyability. Two-thirds of latrine pits were lined to increase structural stability and facilitate mechanized emptying. Several landlords with unlined pits expressed a desire to incorporate a lining into the next toilet they built, but most landlords reported that lined pits were generally built with spaces between bricks to allow liquid to drain from the pit, so that it would last longer (and evidently with little concern for, or awareness of, potential ground water contamination). Landlords also tried to restrict access to the toilet to plot residents only, often through installation of a solid door with an outside lock. Respondents generally reported being able to keep outsiders from accessing their toilets in this way, especially at night when non-residents might sneak into toilets unobserved.

Toilet cleaning responsibilities were usually shared by landlords and tenants. The landlord often formalized these duties by use of a rota, typically an unwritten rotation of the order of households responsible for cleaning the toilet. Each household was responsible for cleaning for 1–7 days at a time. Fines or other sanctions for tenants who did not participate were rare. Rotas with longer turns seemed to run more smoothly, since households were less likely to forget their turn, and to be more enforceable, since it was easier to determine if one of the tenants was regularly failing to clean the toilet. However, longer turns occasionally led to more conflict, and sometimes peace was prioritized over cleanliness. One female landlord reported,

One household wouldn't do the work, so this meant that for the whole week there wasn't any cleaning. This just wouldn't work. We changed to one day only. We didn't push them out, but they eventually left.

Landlords were sometimes included in the rota, while sometimes they simply cleaned the toilet when they observed that it was dirty.

Monitoring the proper use of the toilet was challenging for landlords. They reported that tenants commonly put waste materials into the pit, which would present a problem for pit emptying. Landlords had little idea how to prevent this other than asking that their tenants not do it. Child feces were sometimes disposed into the toilet by use of a small plastic bowl as a 'potty,' but tenants reported that covering their child's feces with dirt or sweeping it into waste piles was also common.

### Improvement preferences

Respondents were asked to rank toilet improvements in order of personal importance. The average toilet preference ranks by role (landlord/tenant) and gender are shown in Table 3 (ordered by average rank by landlords). Respondents reported that locks on the outside of the door were highly desirable because they prevent outsiders from using the toilet, particularly drunk men in the night, who would create a mess that the residents would then have to clean up. A toilet with a seat was ranked highly by some, and cited as more comfortable and accessible to those with disabilities. Others preferred a squatting toilet pan, with a particular concern, especially among women, that a poorly cleaned sitting toilet was more disgusting than a poorly cleaned squatting toilet pan. A place for handwashing was desired, but rarely present in shared spaces on plots. Lined pits were considered important to improve toilet longevity and to prevent collapsing during rainy seasons. Odor-reduction technology was considered important by many, as toilets were frequently located close to shared courtyard areas on plots, but they were rarely present. More

**Table 3.** Toilet improvement preference rankings.

Improvement	Rank by role		Rank by gender	
	Landlord (n = 29)	Tenant (n = 27)	Male (n = 20)	Female (n = 36)
External lock	1	1	2	1
Sitting toilet	2	2	1	2
Lined pit	3	4	3	4
Place for handwashing	4	3	4	3
Place for waste disposal inside toilet	5	9	8	7
Smell reduction (vent or seal)	6	5	5	5
Floor cleaned with antibacterial soap	6	7	6	6
Cleanable tile floor	8	8	7	9
Pit is emptyable	9	6	9	8
Solid roof	10	11	14	10
Walls without holes for privacy	11	12	12	12
Toilet appears clean	12	14	13	13
Financing for improvements available	13	10	10	11
Pit not leaking onto neighbor's plot	14	13	11	14

women than men preferred cleanable tiles, likely because they engaged in cleaning activities more often than men.

### **Improvement motives**

We explored motives for making the improvements preferred by landlords and tenants using our motive mapping tool. In brief, this consisted of showing respondents a series of cards corresponding to status, nurture, love, affiliate, disgust, and create motives (Aunger and Curtis 2013) (Table 4). Respondents ranked the importance of these toilet improvement motives; their top three choices were then assigned points using a simple weighting, with a respondent's first choice receiving 3 points, the second 2 points, and the third 1 point. The number of points achieved out of a total of 3 points possible (if the same motive was ranked first by every respondent) are shown in Table 5.

For landlords, status was the most important motive for improving toilets, while nurture was the most important for tenants. Status, nurture, love, and affiliate, all interpersonal motives, scored higher than disgust overall. But, the responses (both 'first choices' and overall, weighted results) appear to be well distributed among categories, with even the highest ranked motives overall not selected in the top 3 for about half of respondents. This suggests that variation by life stage and household composition may be important.

### **Social relationships**

Though the population density was high, plot residents rarely worked together to achieve common aims. Few residents had preexisting relationships with others on the plot. Three-quarters of plots had no residents from different 'doors' who were friends before moving there, almost half of all plots had no kinship relationships at all between doors, and about a quarter of plots had no relationships of either kind. For those without kin or friends on the plot, respondents mostly reported that their main source of advice or loans was family members living elsewhere in Lusaka or in their village of origin. Neighbors of the same role (landlord or tenant) were asked for help for minor issues like minding a child for a few minutes. The main community organizations that respondents attended were churches; however, people living on the same plot rarely went to the same church.

**Table 4.** Motive mapping tool prompts.

Motive	Definition	Description
Status	Seek to enhance one's position in a social hierarchy	Church elder says: 'Everyone in the community will admire you for doing that!'
Nurture	Rearing offspring	Respondent says to self: 'Now my child will be safe!'
Love	Investment in a pair-bond relationship	Spouse says: 'I love you for doing that!'
Affiliate	Participating in social community	Neighbor says: 'You showed you're like the rest of us. Well done!'
Disgust	Avoiding substances and people that might transmit disease	Respondent says to self: 'That was disgusting. I did well!'
Create	Improving one's local habitat	Respondent says to self: 'I've really made the plot nicer now. I did well!'

**Table 5.** Respondents identifying given sanitation improvement motives as important by plot role.

Motive	Landlord	Tenant
Status	.74	.55
Nurture	.59	.64
Love	.64	.42
Affiliate	.53	.50
Disgust	.40	.48
Create	.10	.42

### **Financial decision-making**

We sought to understand the process of financial decision-making on the plot to identify which individual(s) influenced which plot improvements. A single individual, usually a member of the owner-landlord's household, was generally responsible for financial investment decisions about improving a plot using rental income. The decision-maker sometimes sought input from tenants if the primary goal of the improvement was to increase rental income, such as when adding a water tap. But, such decisions were more frequently made without any such consultation, due to the high turnover rate of tenants. In cases where the decision maker was married, their spouse was often consulted in the decision-making process.

Respondents generally reported that they saved money only for specific planned purchases. The most common savings mechanism reported was a *chilimba*, or 'merry go round.' These are informal agreements made by a fixed number of people with a fixed duration, payout frequency ('rounds'), and financial contribution level. Each participant pays in a fixed amount each round, and one winner is randomly selected per round until each wins. *Chilimbas* had been used by 50% of landlords and 62% of tenants. However, none reported using *chilimbas* to improve a toilet.

More formal financial services were less common in Bauleni. Bank accounts were used by about half of landlords and about a third of tenants, but formal loans were rare. Respondents feared that the loaning institution could seize the property of a delinquent debtor – a particular concern for those with irregular income. A few landlords gave the money to a nonresident kin and asked them to save it on their behalf. The remaining one-third of both tenants and landlords reported never using any kind of formal or informal savings or loan mechanism.

Regular rental income was the main source of funds for plot improvement. The average landlord made about Kw1,450 (\$153 USD) per month from rental, or Kw350 (\$37 USD) per tenant household. Several landlords reported that a high-quality toilet could be constructed for around Kw3,000 (\$316 USD), including materials and labor for a lined pit, concrete slab, solid walls, door, and roof, and a pour-flush or flushing toilet pan. Rental increases of Kw50 (\$5 USD) per month per tenant household were reported, so construction costs could be fully recouped in less than two years. One female landlord related the following story (paraphrased):

[We] live on one plot and own another one as well. We have two tenant families living on the other plot, which already has a toilet, and are building three more rooms there as well as two on this plot. This plot doesn't currently have a toilet, but we will build one after finishing the other plot. No one else is living on this plot, and they won't until we build a toilet ... but my husband's company is not earning much and he's not getting much salary, so our plans are shattered.

Sanitation was rarely seen as an investment by landlords, but instead as a required service to be provided, as tenants would not stay on plots without a working toilet for long.

### **Discussion**

This study explored features of sanitation service provision in peri-urban Lusaka to inform the design of a behavior change intervention. Below we organize the findings according to the behaviors of interest and their determinants (environmental, psychological, and settings based).

#### **Social environment: weak social cohesion**

Social relationships and influences played an important role in toilet quality improvement and maintenance behaviors. However, social cohesion was weak both within the plot and at the

community-level. Other than kin living on the same plot, landlords rarely consulted with those on their plot or others living nearby. Enforcement of formal regulations requiring functioning toilets to be present on the plot were non-existent, and few informal norms about sanitation quality existed. Landlords also ranked affiliation, the sense of belonging to the local community, as less important than comparative social motives (status) or kin-focused motives (love, nurture).

### ***Motivated brain: drivers of sanitation quality***

Motives that drive sanitation quality improvement varied substantially within this population and from those identified in other contexts without landlord–tenant shared toilets. Status was the highest ranked improvement motive, with nurture, love, and affiliation all also scoring higher than disgust. Disgust is a key motive for toilet construction in some contexts (Routray et al. 2015), but may be less important for improvements in Bauleni due to a higher baseline level of sanitation quality, shared cleaning responsibilities diluting each individual’s direct contact with contamination, and perhaps becoming accustomed to the sight or smell of feces through being frequently in close proximity to toilets very close to living spaces. But, it is also possible that respondents were reluctant to even talk about disgust during the survey. Status is a major motive for improving sanitation in other places where users build their own toilet (Jenkins and Curtis 2005), and may be an effective way to drive upgrading in this context. But, it is unclear if landlords would gain status from improving a toilet used only by their tenants. The affiliation motive was also sometimes considered important, despite the weak social cohesion described above. It is plausible that a landlord’s need to be perceived as fitting in the community is strong enough to drive sanitation improvement behavior. Though not included in our sanitation motive mapping tool, the hoard motive (the desire to store up resources (Aunger and Curtis 2013)) was reported as a driver for landlords investing in their plots for long-term financial security against income shocks, but this was infrequently associated directly with sanitation.

### ***Executive brain: landlords don’t consider sanitation an investment***

Landlords generally considered sanitation as a basic service to provide, rather than as a financial investment in their plot. This is similar to findings in other PUs with landlord–tenant dynamics, though usually limited to the provision of a toilet in general (Isunju et al. 2011; Pippa et al. 2013). Based on the costs of locally available improvements and potential for increasing rent, we calculated that the return on investment for sanitation improvements may make it a worthwhile investment option for many landlords. As most toilet improvements cost far less than adding additional rooms to a plot, there is also less risk that they will sit incomplete for long periods of time and not generate any return on investment. *Chilimbis* (savings groups), which are generally used only for investments or necessary expenditures, could further expedite this process if sanitation were viewed as an investment.

Encouraging landlords to view sanitation as an investment may also bridge what appears to be a landlord–tenant motive gap. When landlords view sanitation as a basic service to fulfill the desires of tenants for increased comfort or decreased fear or disgust, sanitation spending competes with other expenditures that may more directly benefit the landlord. Landlords may prioritize sanitation improvements when they realize that they can use increased rental income to attain status, express love (for a partner), nurture (for offspring) or simply hoard resources as described above. This may be more effective than if interventions emphasize tenant motives or relational motives between landlords and tenants. Financial gain, rather than being the ultimate end, motivates landlords to improve tenants’ sanitation experiences by leveraging tenants’ willingness to pay to enable landlords to perform behaviors they are motivated to do. This finding may be potentially be applicable to other settings with landlord–tenant dynamics and shared sanitation, though it seems likely that tenure strongly mediates the significance of the finding.

### **Implications of the formative research**

While most plots in the study area have some form of toilet, the infeasibility of eliminating shared sanitation, low quality of most toilets, lack of motivation to improve structural quality, and difficulty of ensuring proper cleaning and use of toilets are major barriers to improving sanitation to improve public health.

Weak social cohesion may limit the effectiveness of sanitation interventions as used in other contexts. One of the most widely practiced rural sanitation promotion programs, CLTS, leverages community cohesion to enforce social norms (Kar and Chambers 2008). It has been suggested that this might be adapted to urban contexts, so-called Community-Led Urban Environmental Sanitation (Lüthi et al. 2011), but the scope for such coordinated action seems limited in Bauleni. The weak relationships within plots may hinder intra-plot coordination, and weak inter-plot bonds may limit community-level action (Ostrom 2002). Additionally, the lack of strong local leadership may limit the effectiveness of such approaches.

Targeting appropriate motives through sanitation marketing may be more effective. Landlords have the primary role in driving sanitation improvement, but most are motivated to improve their plots by financial gain, increasing social status, and caring for their own families. These motives are not strongly related to the well-being of tenants. Our findings suggest that reframing sanitation improvement as an investment may allow landlords to leverage latent demand from tenants and use existing financing mechanisms to gain financially and improve their social status via provision of better sanitation services.

A further route for sanitation improvement may lie in better plot-based systems for cleaning. New and better rotas prompting tenants when it's their turn, allowing landlords to monitor participation, and perhaps even establishing sanctions when tenants fail to clean, may lead to improved interface cleanliness and benefit the landlord's own family.

A wide variety of actors, interactions, and decisions are involved in the process of sanitation improvement. We identified a range of problem behaviors that could be tackled through intervention. New toilets are usually built when existing ones failed. Many important behaviors of individual toilet users, whether failing to clean, putting undesirable waste into the toilet, or failing to put child feces into it, are challenging for a landlord to monitor. Cooperation is limited by barriers between landlords and tenants, with tenants failing to express sanitation improvement preferences or willingness to pay, and landlords failing to proactively solicit tenant feedback. It is difficult for households to keep consumable cleaning materials like soap and water in the shared public space on the plot without others taking them. Few governmental and informal regulatory mechanisms exert pressure to improve sanitation. The variety of kinds of problematic behaviors and actors identified shows the benefits of using a behavioral theory-driven process is to gain a comprehensive understanding of unexplored, behaviorally driven health problems.

The best approach for a landlord to achieve sanitation quality improvement, either through unilateral action or coordination with tenants, may depend primarily on the type of plot. For plots where a landlord's kin or friends are present, identifying tenants' improvement priorities may be effective. But for many plots, it may be simpler for landlords to act unilaterally to improve plot sanitation, potentially offsetting costs by raising rent, and replacing any tenants who leave.

The use of a behavioral theory-driven framework for formative research around a set of sanitation behaviors, rather than a more general qualitative approach, enhanced the study. The process transformed sanitation quality improvement behaviors from broad generalities to specific kinds of improvements to be made by specific actors in relationships with other actors. We identified behavioral scripts and action selection processes that led us to specific intervention targets. We established which improvements were perceived as most important and what motives may be the most effective levers of behavior change. This theory-driven process can be useful for behaviors where little is known, to provide a framework for initial investigations, and for well-studied behaviors, to illuminate exactly what findings from other contexts might be most applicable.

## Conclusion

This first study of a broad range of shared, on-site sanitation maintenance and improvement behaviors identified several barriers while suggesting feasible solutions. Major barriers included poor coordination among tenants, a lack of communication between landlords and tenants, and landlords viewing sanitation as only a required basic service to provide. Consumer-driven, sustainable improvements may be motivated by making the tenant experience of shared sanitation more tangible to landlords, leveraging tenant willingness to pay to drive intentional investments in toilet improvements, and introducing better shared cleaning systems. Overall, these findings imply that well designed, demand-side interventions may be able to increase both the structural quality and the hygiene of peri-urban sanitation systems and demonstrate the benefits of theory-driven formative research for behaviors about which little is known.

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## Declarations

Consent for publication: Not applicable

Availability of data and materials: De-identified data is available upon request from study PI.

## Disclosure statement

No potential conflict of interest was reported by the author.

## Ethical approval

Ethical approval and consent to participate: This study was approved by the London School of Hygiene and Tropical Medicine Research Ethics Committee (ref: 11714) and the University of Zambia Biomedical Research Ethics Committee (ref: 023-06-16).

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## ORCID

James B. Tidwell  <http://orcid.org/0000-0001-5868-6584>

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