"The difference that makes a difference": highlighting the role of variable contexts within an HIV Prevention Community Randomised Trial (HPTN 071/PopART) in 21 study communities in Zambia and South Africa

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ABSTRACT

This paper explores contextual heterogeneity within a community randomised trial HPTN 071 (Population Effects of Antiretroviral Treatment to Reduce HIV Transmission) carried out in 21 study communities (12 Zambian, 9 South African). The trial evaluates the impact of a combination HIV prevention package (including household-based HIV counselling and testing and anti-retroviral treatment (ART) eligibility regardless of CD4-count) on HIV incidence. The selection, matching and randomisation of study communities relied on key epidemiological and demographic variables and community and stakeholder support. In 2013, following the selection of study communities, a "Broad Brush Survey" (BBS) approach was used to rapidly gather qualitative data on each study community, prior to the implementation of the trial intervention. First-year process indicator intervention data (2014–2015) were collected during the household-based intervention by community lay workers. Using an open/closed typology of urban communities (indicating more or less heterogeneity), this qualitative inquiry presents key features of 12 Zambian communities using a list of four meta-indicators (physical features, social organisation, networks and community narratives). These indicators are then compared with four intervention process indicators in a smaller set of four study communities. The process indicators selected for this analysis indicate response to the intervention (uptake) amongst adults. The BBS qualitative data are used to interpret patterns of similarity and variability in the process indicators across four communities. We found that meta-indicators of local context helped to interpret patterns of similarity and variability emerging across and within the four communities. Features especially significant for influencing heterogeneity in process indicators include proportion of middle-class residents, proximity to neighbouring communities and town centre, the scale of the informal economy, livelihood-linked mobility, presence of HIV stakeholders over time and commitment to community action. Future interdisciplinary analysis is needed to explore if these patterns of difference continue to hold up over the full intervention period and all intervention communities.

Introduction

The HPTN071 (Population Effects of Antiretroviral Treatment to Reduce HIV Transmission [PopART]) trial is a cluster randomised trial designed to determine if a community-wide combination HIV prevention approach in 21 large urban communities in sub-Saharan Africa can reduce HIV incidence. The 21 study communities are catchment areas of government health facilities, 12 in four Zambian provinces and 9 in Western Cape, South Africa. (Hayes et al., 2014). These communities were matched for certain key characteristics prior to randomisation but, in addition, have other similar and diverse features.

The distinctive disciplines (epidemiology, anthropology, health economics, etc.) involved in the this community randomised trial (CRT) recognise the heterogeneity

of these communities, often accommodating and describing the diversity in the selection and analysis processes, using particular disciplinary techniques. Focusing on contextual heterogeneity, labelled as "effect modification" by epidemiologists (Porta, 2014), this paper draws together qualitative data on social context and quantitative data on the uptake of a community-based HIV intervention in study communities to explore what aspects of social context contribute to variability in response. An "open/closed" typology model, which places urban landscapes along a qualitative scale of more or less heterogeneity with implications for change and uptake of interventions (Wallman, Bond, Montouri, Vidali, & Conte, 2011), is used as the analysis framework. As Meadows and Wright have explained, "the same outside event applied to a different system is likely to produce a different result" (2008, p. 2). By identifying that there are differences in local context, and the differences that makes a difference to the uptake of the intervention, the intention is to demonstrate the importance of an interdisciplinary interpretation of what influences variability patterns in uptake and outcomes.

When implementing community-based HIV research and interventions, adjustments often have to be made to accommodate local context. Context encompasses individual and household circumstances, community characteristics/features, health systems and wider policy and programmes. Contextual factors can influence local options for managing HIV and the ability of both individuals and households to respond to the epidemic. Community randomised trials (CRTs) address contextual variability through statistical balancing of a limited set of variables that are understood to be likely to be associated with trial outcomes.

While these purely statistical techniques are unlikely to deal adequately with contextual variability, bringing the "mess" of context into an analytical frame and teasing out the differences has its own challenges. Although social scientists may wish to accommodate as many features of complex urban communities as possible (Kosko, 1993), in order to compare one community with another, one form of data with another, and to move across a number of communities at the same time, it is necessary to be selective and systematic and also use a degree of abstraction (Wallman et al., 2011). In their comparison of different urban settings, Wallman et al. (2011, p. 2) emphasise, "The fact that computers can handle any number of variables is beside the point; urban places vary as systems of relationships, but not in ways that can be counted" (Jacobs cited by Wallman et al., 2011, p. 197).

Specifically, the comparison of the contextual data used in this paper brings together the matching and randomisation process of the CRT itself, findings of a particular qualitative methodology, an analytical framework which uses four key cross-comparative features (referred to as "meta-indicators") to assess the degree of heterogeneity, and process indicators of intervention participation and uptake in the first year of the HIV combination prevention intervention.

Methods

The data used in this paper were collected in 2013 during the initial selection of the 21 HPTN071 study communities, a Broad Brush Survey (BBS) of study communities and the restricted randomisation of study communities to different intervention packages, and the process indicator data collection 2014–2015 during the first year of the CRT.

The study communities were selected on the basis of relatively high pre-trial HIV prevalence (estimated to vary from 12–23%), geographical area and the availability of implementing partners for HIV services and government clearance to participate in the research (Hayes et al., 2014). Study communities were then grouped into seven matched triplets according to population size, anti-retroviral treatment (ART) coverage and HIV prevalence for randomisation into one of three different intervention Arms (A, B and C) (Hayes et al., 2014). This randomisation process aimed to "achieve adequate balance on the three variables" (Hayes et al., 2014, p. 17).

Once the study communities had been identified, a BBS was carried out in each for a period of 12 days. The BBS is a set of rapid, qualitative and participatory research methods that aim to capture key features of urban landscapes (Wallman, 1984, 1996, 2003; Wallman et al., 2011) used in at least three CRTs in Zambia and South Africa (Bond, 2011; Murray et al., 2009; Sismanidis et al., 2008; Stringer et al., 2013). Four meta-indicators of the open/closed typology that span physical features, social organisation, networks and community identity narratives and facilitate comparison between and within urban communities, were developed by a research group aiming to classify the "capability" of response to change (Wallman et al., 2011). HPTN 071 (PopART) was the first opportunity to use these indicators as an analytical framework for BBS findings.

In HPTN 071 (PopART), the BBS method included group discussions, key informant interviews and observations. A total of 1006 individuals (597 women, 409 men), selected on the basis of qualitative representation of age, gender and experience with HIV and local health issues, participated in the research across the 12 Zambian study communities. Observation activities

(*n* = 140) were carried out in transport depots, in areas surrounding the government health clinics, within the clinics, in economic and recreational gathering places, in churches and at events of relevance (e.g., a mobile voluntary counselling and testing [VCT] campaign). Observations were conducted during the day, at night and during weekends. Group discussions (*n* = 81) were held with community health representatives, local HIV specialists, older and younger women and men and people living with HIV (PLWH). Key Informant interviews (*n* = 66) were held with health facility staff, local pastors, traditional healers, community leaders and HIV activists. The bulk of the fieldwork was carried out by graduate social scientists, with support from research assistants and the lead social scientists. Ethical clearance was obtained from institutional and country ethics review committees and from national health authorities. The initial analysis of BBS findings, based on a rapid assessment of the data, was carried out in 2013 to produce a report on each community and an overall technical report (Bond et al., 2013) with the aim of informing the trial itself.

The selected process indicators (see Table 1) evaluate four aspects of intervention uptake amongst adults in the first year of the intervention (2014–2015). Adult clients of the HPTN 071 PopART intervention are defined as in the age 18 and above normally living in households falling within a defined catchment area of a government health facility, which delivers HIV services including ART. These data are collected by community lay workers carrying out the intervention using Electronic Data Collection devices.

For the purpose of this inquiry, the analysis comparing qualitative and intervention data was limited to four Zambian Arm A communities and results from four process indicators at the end of the first intervention year. The Arm A combination prevention intervention consists of universal household-based HIV testing, linking PLWH to care and immediate eligibility for ART (Hayes et al., 2014). This inquiry was limited to four communities for trial regulatory reasons but also to explore the value of this particular analysis for future work.

Findings

Heterogeneity

The communities are different from each other in ways that go beyond the three variables employed for CRT matching and randomisation. Initially, such comparisons might be based on visible features, for example, a brick wall around a clinic compared to a wire fence, or the existence of transport hubs in all places. As more time is spent in the communities, and partly based on conversations with people there, more implicit comparisons start to emerge. Intuitively, it makes sense that any variability in these explicit and implicit features of each community would affect how HIV is experienced and managed. These variable features reach beyond the set of characteristics accommodated in selection and randomisation processes and are more in number, more a matter of degree more complex and messier. To work through some of this messiness (Kosko, 1993) and present a more comparative model, the predetermined meta-list of four key features used in the open/closed typology model is used to present and compare features.

Key features – meta-indicators of 12 Zambian study communities and relevance to HIV

In Table 2, the four meta-indicators span both visible and (less visible) relationship features of the 12 urban study

Table 1. Definition of selected process indicators, HPTN071/PopART.

Indicator	Numerator	Denominator
Proportion of adult (≥18 years) household members who know their HIV status, from a prior HIV-positive test result or acceptance of the offer of HIV testing by CHiP teams	Number of adult (≥18 years) household members tested for HIV by the CHiP team and/or self-report they are HIV-positive	Number of adult household members who consented to participate in the intervention, among enumerated households
Adults who refuse to participate in the intervention	Number of adult household members who refused (verbally) to participate in the intervention	Number of adults who were enumerated as a household member, among households that gave permission for household members to be enumerated
Adults not contacted by the intervention	Number of adult household members who could not be contacted by CHiPs during repeated household visits and could therefore not be invited to participate in the intervention	Number of adults who were enumerated as a household member, among households that gave permission for household members to be enumerated
Proportion of HIV-positive adult household members who started ART within three months of being referred to HIV care by a CHiP team	Number of HIV-positive adult household members who start ART within three months of being referred to HIV care by a CHiP team	Number of HIV-positive adult household members who were referred to HIV care by a CHiP team, among adults who either self-reported they were HIV-positive or accepted the offer of HIV testing from CHiP teams and the test result was HIV-positive, and were not taking ART at the time of the annual round visit

Note: Community Lay Workers working for HPTN071 to deliver the household-based intervention are called Community HIV care Providers (CHiPs).

Table 2. Key features of 12 Zambian study communities within the four meta-indicator framework, open/closed typology.

Meta-indicators	12 Zambian study communities
Physical features	**Type of terrain (boundaries, topography), infrastructure, population mix and economic options found in the community**
Terrain and physical boundaries	All communities are urban, two on an international border. Some more porous than others (many/few entry/exit points). 5/12 better road networks. All situated on low-lying land, prone to seasonal flooding. Limited access to water, toilets and waste disposal
Infrastructure and population	Common to all: government clinic/s, churches, transport depots, market areas, education facilities, communal facilities, police posts, football pitches, recreational facilities (including drinking places). Private clinics present in seven communities. Few secondary schools. Population growing with a core group of long-term residents. Transient populations often newcomers, poorer and non-national
Population diversity, ethnicity, age and class	Population size estimates range from 22,500 to 100,391. Most residents in lower socio-economic status bracket. Small but growing presence of a middle-class. Mix of age groups, dominated by a younger age group. Mix of ethnic and language groups and small representation from other African countries
Employment, work, economic options	No welfare state. Limited formal employment options. Unemployment, particularly amongst youth. Providing sex in exchange for cash or goods is a livelihood option for some women. A few have industrial presence within or on the boundary
Social organisation	**The relationship between people and place, including between local residents and housing, work, transport, local services, mobility and local HIV stakeholders**
Distribution housing options across residents	Housing type mirrors social classes, with most urban working class residents residing in smaller housing and more likely to rent accommodation. Transient populations rent accommodation and are more likely to move out of as well as within a community
Distribution of categories of population across work options	Residents 18–45 dominate informal trading economy. Older residents more likely to be landlords. Entrepreneurial spirit of young people evident. Youth (i.e., younger than 30) mostly rely on casual work. Young men engaged in street vending, casual work (construction, physical labour), transport jobs or security work. Young women mainly involved in food and clothes trading in markets or domestic work (including childcare). Some young women earn a living from sex work or boost income through transactional sex
Access: transport/local services	Government clinic in walking distance for majority of residents. At least one taxi and bus stations in each community
Population movement in and out	Population movement embedded in livelihood patterns. Some traders coming into communities to sell goods spend nights under stalls or in communal spaces and some residents spend nights outside the community. Charcoal, fish and cross-border trading involve leaving the communities for longer periods
Presence/absence of HIV stakeholders	Since the 1980s, HIV is remembered as falling into distinct phases defined by absence/presence of HIV initiatives. In all study communities, the government health facility is perceived as the main HIV-related service provider/stakeholder. Average of 14 stakeholders delivering HIV-related services, including voluntary medical male circumcision and HIV testing (couples; home-based; mobile) identified. In three study communities, more than one health facility provided ART. Seeking faith healing and traditional medicine was reported in all
Networks	**Relationships between people through patterns of connection, spread and boundaries, social capital and networks of particular significance to HIV (alcohol, drug use and transactional sex networks)**
Patterns of connection relationship	Residence, kin, religion and occupation are often as strong as ethnic connections
Network spread and boundaries	Networks emanate from kin, peer groups, gender groups, class, livelihood options, schools, church affiliations, length of residence in the community, leisure activities and/or recreational spaces, transport depots, geographical zones, party political and civil society affiliations and community-based initiatives (including health). Many relatively local and intensive but trading, kin, church and political/civil society networks extend beyond the community. Some networks (e.g., class) more closed than others
Social capital	Social links exist between long-term residents, within livelihood and recreational activity groups. Tension between younger and older age groups common, with younger groups blamed by older people for social ills. Community action highly valued and aspired to by most established residents in communities, and is engendered by hardships
Networks of particular significance to HIV	Alcohol use, drug use and transactional sex networks identified as linked to HIV risk. Alcohol use is evident at any time of the day but more especially in evening and at weekends. Men most frequent drinkers, but younger women increasingly perceived as drinking. Participants regarded alcohol use as a barrier to HIV testing and treatment and related how it could lead to risky sexual behaviour. Alcohol use is also linked to arguments and violence – both bodily harm and rape. Alcohol considered a coping mechanism against harsh social circumstances. Drinking places targeted in HIV outreach activities and condoms often for sale Recreational drug use a growing problem. Marijuana use amongst younger men said to be widespread. Few reports of ART being "smoked" or "sniffed" as a recreational drug – for this purpose, ART could be stolen or sold Openly practised sex work evident. Female sex workers sometimes attached to recreational facilities in community or in town centre where they can rent rooms. Less overtly, women traders sometimes exchange access to wares for sex – sometimes a business arrangement but sometimes more opportunistic and/or forced. Some women who drink alcohol are said to exchange alcohol for sex
Narratives	**The defining characteristic of a particular community**
General	Most communities initially listed negative attributes about "their place". These included: unemployment, limited recreation and educational opportunities, alcohol abuse, marijuana use, overcrowding, transactional sex and sex work, early marriage, teenage pregnancy, rainy season diseases (malaria and cholera), flooding, poor water and sanitation, poverty and hunger and street kids
Poverty	Most adult residents dependent on own endeavours in the informal economy. They struggle to manage periods of sickness, "hunger" linked to TB and HIV medication and other health needs, despite the presence of government health and education services
Crime	In six communities, lack of safety, particularly at night and weekends. Other communities took pride in safety of their communities
Community solidarity	Positive attributes which emerged include: safety, high birth rate, small-scale trading, socialising, cohesiveness, being quick to take up new initiatives, good communication channels and friendliness. Long-term residents had a strong commitment to the place they lived in

communities (Wallman et al., 2011), summarising both similar and diverse features. To maintain anonymity of study communities, the meta-indicator detail for each of the four Arm A study communities is not separated out in Table 2. Absence/presence of HIV stakeholders and networks of particular significance were additions made to the original meta-indicator framework because of the HIV research focus. Based on existing knowledge, most features under each of the four meta-indicator have relevance for HIV, being associated either with an expected increase in vulnerability for acquiring HIV (e.g., cross-border trading options) or as an influence on HIV management and dynamics (e.g., past exposure to HIV programmes) (Vermund et al., 2013).

Influence of local context on intervention participation and uptake

Narrowing down to focus on four intervention communities, Table 3 presents the results from four process indicators. Study communities are referred to through the use of numbers to ensure anonymity: the four Arm A communities are Z2, Z5, Z8 and Z10. For each community, emerging overall patterns are summarised in Table 3. Estimated population size varies between 24,000 (Z2) and 100,000 (Z8) across the four communities. It should be noted that some differences across and within communities may not be statistically different (as defined by a 95% confidence interval) but are, for the purpose of this analysis, considered qualitatively different when they are compared to each other. Across the four communities and process indicators, three pertinent issues, discussed below, emerge in the comparative responses to the household-based intervention: the level and comparison of knowledge of HIV status amongst adults following contact with the household-based counselling and testing intervention, the presence and participation of men and the low uptake of ART within three months amongst adults testing HIV-positive with the intervention.

Knowledge of HIV status amongst adults in first year of the intervention

Most adults either agree to be tested for HIV by the community lay workers or, if HIV-positive, share their HIV status. This demonstrates widespread openness to being tested across all four communities and to sharing an HIV-positive diagnosis with community lay workers during the first intervention year period. Although men overall are less likely to take up this testing or share an HIV-positive diagnosis opportunity, the difference is not that pronounced. This suggests that most men, if found, are willing to be tested.

Interestingly it is Z2, the most middle-class community, where uptake of this opportunity to test or share an HIV-positive diagnosis is the lowest (59%) and lower still amongst men (52.9%). Drawing on the HIV stakeholder organisation detail under the social organisation meta-indicator, Z2 stands out for having had far less exposure to household-based testing and fewer HIV initiatives in the past, which might contribute to less openness. The BBS also found that residents in Z2 found testing at the clinic too visible and preferred to test elsewhere. Z2 residents also expressed a preference for non-resident community lay workers to carry out household-based testing.

By contrast, in Z5 (located in the same province as Z2), proportionally more adults took up this opportunity. In BBS, Z5 listed 17 different HIV stakeholder organisations and a high number of HIV testing options outside but close to the community. Z5 residents also highlighted the important roles of a local NGO, the clinic, a church Home-Based Care programme and intermittent VCT service delivery in promoting HIV testing (from 2003). However, residents of Z5 also preferred non-local lay workers for household-based testing and had a tendency to test away from the community.

Men's participation and presence

High participation rates for accepting to participate in the household-based counselling and testing intervention were consistent across all four communities. This reflects the same pattern of openness to and familiarity with household-based testing opportunities noted above and, additionally, the widespread acceptability of ART noted in BBS. Men's slightly lower acceptance rate to participate in the intervention, problems with finding men and lower knowledge of HIV status amongst men are also consistent patterns. Across all study communities, men were often not found at home, some being in bars drinking alcohol from mid-morning onwards and others (young men in particular) being driven by the lack of formal employment to rely on livelihood options that entail being mobile.

The pattern of lower male participation is less notable in Z2 where, relative to the other three communities, men are more likely to be contacted and there is less difference across all indicators between men and women. This could partly be due to a stronger middle-class presence and more formal employment options. Furthermore, the location of the community further from the centre of town could increase men's presence at home at more predictable times. The informal economy dominates more in Z5, Z8 and Z10.

Table 3. Four Zambian Arm A study communities process indicator results, cumulative for first year of the intervention (2014–2015), HPTN 071.

Process indicator	Study community: Z2			Study community: Z5			Study community: Z8			Study community: Z10		
Adults who know their HIV status	**Overall:**	7382/12510	59.0%	**Overall:**	19327/23076	83.8%	**Overall:**	37174/49329	75.4%	**Overall:**	10678/16663	64.1%
	Men:	3006/5682	52.9%	**Men:**	8301/9941	83.5%	**Men:**	16987/22921	74.1%	**Men:**	4325/7066	61.2%
	Women:	4376/6828	64.1%	**Women:**	11026/13135	83.9%	**Women:**	20187/26408	76.4%	**Women:**	6353/9597	66.2%
Adults who refuse to participate in the intervention	**Overall:**	812/13975	5.8%	**Overall:**	1201/29748	4.0%	**Overall:**	4921/57672	8.5%	**Overall:**	1024/20303	5.0%
	Men:	430/6506	6.6%	**Men:**	682/14861	4.6%	**Men:**	3091/28601	10.8%	**Men:**	660/9590	6.9%
	Women:	382/7469	5.1%	**Women:**	519/14887	3.5%	**Women:**	1830/29071	6.3%	**Women:**	364/10713	3.4%
Adults not contacted by the intervention	**Overall:**	602/13975	4.3%	**Overall:**	4991/29748	16.8%	**Overall:**	2914/57672	5.1%	**Overall:**	2455/20303	12.1%
	Men:	372/6506	5.7%	**Men:**	3993/14861	26.9%	**Men:**	2339/28601	8.2%	**Men:**	1761/9590	18.4%
	Women	230/7469	3.1%	**Women**	998/14887	6.7%	**Women**	575/29071	2.0%	**Women**	694/10713	6.5%
Adults LWH starting ART within three months of community Lay worker referral	**Overall:**	111/362	30.7%	**Overall:**	461/1593	28.9%	**Overall:**	626/2746	22.8%	**Overall:**	193/977	19.8%
	Men:	26/88	29.5%	**Men:**	167/562	29.7%	**Men:**	221/945	23.4%	**Men:**	51/273	18.7%
	Women:	85/274	31.0%	**Women:**	294/1031	28.5%	**Women:**	405/1801	22.5%	**Women:**	142/704	20.2%
summary of intervention outcomes patterns	Almost 95% of adults contacted participated in the intervention with few differences between men and women across all indicators (with men slightly less likely to be contacted or know their HIV status). Knowledge of HIV status is notably lower in this site (compared to other Arm A communities) and ART uptake within three months of testing positive through the intervention is the highest, but still low			Highest uptake of intervention participation (96%), striking differences between men and women not contacted (with men much less likely to be contacted), the highest number of adults who already know their HIV status and the second highest uptake of ART, but again, still low (29%)			Compared to other communities, lower participation in intervention, but still high levels (91.5%). Men are less likely to participate and be contacted, but minimal difference between adult men and women who know their HIV status and uptake ART. Knowledge of HIV status amongst adults is high but not as high as Z5, and uptake of ART is lower than Z5 and Z2 with almost 23% starting ART within three months			High participation rates in intervention (95%) and sustained difference between men and women across indicators, with men less likely to participate, be contacted, to know their status, and uptake ART. Difference in men is particularly marked in adults not contacted (18% of men). Knowledge of HIV status is lower than Z8 and Z5, but higher than Z2. Uptake of ART within three months is lowest at just under 20%		

Note: knowledge of HIV status is defined as adults sharing a prior HIV-positive test result or acceptance of the offer of HIV testing by community lay worker teams (see Table 1). LWH, living with HIV.

In community Z5, by contrast, close proximity to the town centre and a particularly high level of poverty is likely to underlie the high number of men not contacted. More specifically, in Z5, traders were noted to spend long days in markets both within and outside the community, and men were more likely to trade outside the community than women. BBS fieldworkers observed that parts of Z5 felt "a bit deserted in the day".

Similarly, in community Z10, difficulties contacting men could be linked to its specific employment and mobility patterns. The community's location close to an international border and on two major roads has stimulated cross-border trading and mobility. Fishing is also a livelihood option in Z10, mainly for men, requiring periods away.

Z8 is more puzzling; it has similar household structure, patterns of drinking, informal economy system and mobility patterns to Z5 and Z10. Yet, relative to Z10 and Z5, many more men have been contacted in this site, which is the closest to the national capital. The reason for this could lie in the longer presence of HIV programmes, including household-based and mobile HIV testing campaigns. The BBS HIV timeline exercise, which mapped awareness of HIV and arrival of HIV-related initiatives, documented HIV awareness and action beginning in the early 1990s and listed a total 20 HIV stakeholder organisations. This exposure to HIV programmes is reflected also in the relatively high knowledge of HIV status and research team observations of men approaching CRT staff asking to be tested. Z8 residents also report that they pride themselves on a sense of solidarity engendered by communal hardships, corresponding with this openness and willingness to be contacted and tested for HIV.

Uptake of ART initiation within three months

Uptake of ART within three months for people who test HIV-positive with the intervention is similar amongst men and women living with HIV. In two communities (Z8 and Z5), however, men are slightly more likely to take up ART within three months. Men's mobility and authority may contribute to them finding it easier than women to start ART, either within or outside the community (there are other options for accessing ART from government clinics and/or NGOs close by in Z2, Z8 and Z10). Overall, however, the uptake of ART within three months was low across all communities. It should be noted that ART initiation by 12 months was substantially higher, suggesting that initial challenges in uptake are overcome in time. Low uptake close to HIV diagnosis indicates cross-cutting contextual challenges, as well as psychosocial challenges that are not addressed by this current analysis.

Differences across communities in linkage to care outcomes can be partly explained by differing intensities of factors such as accessibility of services, and alternative options for managing HIV (particularly faith healing), combined with the possible influence of class and mobility. The higher uptake rates in Z2 could be influenced by better quality middle-class education, other options for accessing ART nearby, lower mobility, smaller population size (which decreased clinic congestion) and less reliance on the informal economy. The lower uptake of ART in Z10, by contrast, could be influenced by cross-border trading and high mobility, a clinic process that singled out PLWH throughout (heightening anticipated stigma), and the unusual presence of religious groups who generally oppose bio-medical treatment.

In Z5, where uptake of ART was about 29% (the second highest but still low), mobility is pronounced and health staff said that they found it hard to "convince" PLWH to start treatment. In this community, alcohol use is high, the population is large and the clinic is very congested. Additionally, ART services at the clinic are located close to the entrance gate and PLWH during BBS requested that a wall be built to shield them from view.

The community Z8, which had the second lowest ART uptake, has the largest population. Considerable congestion at ART services was noted during BBS. The ART services are situated by Maternal and Child Health services and this was said to put some PLWH off accessing treatment there. Z8 also has a pattern of residents moving house frequently within or close to the community, disrupting follow-up. Alcohol use, a strong faith healing movement, alternative sources of other pharmaceutical drugs and herbal remedies were identified by Z8 residents during BBS as undermining linkage and adherence to ART. Residents recalled having that many lives had been lost due to PLWH on ART "throwing away their drugs in the name of deliverance".

What is the difference that makes a difference?

Combining a limited number of results from process indicators with key features of the four communities reveals similarities and variability in results. Responses to the CRT intervention is influenced by some features common to all communities (e.g., mobility), by the degree to which these features are manifest in a particular community (e.g., more or less drivers for men's mobility) and critically, by how all these features combine within a particular local system (e.g., the informal economy driving men's mobility combined with close proximity to a town centre).
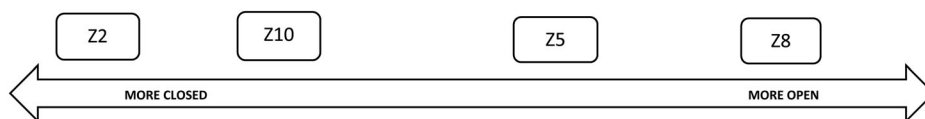
Figure 1. Four Arm A study communities placed on an open/closed typology qualitative scale.

The four meta-indicators employed in the BBS allow us to begin to identify what differences might make a difference to residents' ability to be contacted by intervention staff, to participate in the study, to know their HIV status and to start ART within three months. These significant features are summarised in Table 4.

Comparing the meta-indicators and the results from process indicators also allows us to place the four communities on a qualitative scale of open/closed or more or less heterogeneous (see Figure 1). Z2 clearly sits nearest to the closed end of this scale; with historically fewer HIV efforts, it is more homogeneous in class and employment, initially resistant to knowing more about HIV but, if people are diagnosed HIV-positive, they were enabled by this to start treatment within three months. Z10 is placed on the open/closed scale near Z2 and although more fluid and busy than Z2, it exhibits many more closed features in its comparative resistance to HIV testing and ART uptake. In BBS, Z10 was described as a "relatively tight-knit community with heightened HIV stigma locked into cross-border trading and concerned about beer drinking". Both Z5 and Z8 are relatively open. Z8 is more heterogeneous in class and housing, located in the capital and relatively stable with a strong history of HIV interventions. Z5 also has a strong history of HIV interventions but is less heterogeneous in class and housing, more chaotically open and more fragile with deeper poverty and fewer services and opportunities. Zarowsky, Haddad, and Nguyen (2013) state that "a high degree of variability in health outcomes […] reflects a high degree of vulnerability in the overall system" (2013, p. 8). This fits with the variability across outcomes for Z5 and Z10 which emerge, for similar and different reasons, as more erratic and vulnerable communities.

Conclusion

The intention to expose and explore the impact of contextual heterogeneity, through analysing variability in response to HIV interventions across and within communities participating in a CRT, was built on an interdisciplinary commitment and knowledge that HIV "needs to be seen in the context of everyday life" (Seeley, 2014, p. 91). Community-level contextual factors were compared (or correlated) with measures of uptake at community level, an approach similar to an epidemiological ecological analysis (Porta, 2014).

This analysis was, moreover, intended to be useful to understanding how best to reduce HIV, the primary aim of the trial itself, by exploring which meta-indicators of context were salient for understanding differences in intervention response and participation. This is helpful during the intervention for understanding patterns of response (and thereby better addressing them) and may later be important for understanding the eventual intervention outcomes for the trial. For example, differences in reductions in HIV incidence across and within communities could be partly understood by systematically drawing on contextual detail.

The BBS approach and the meta-indicator framework proved robust for collecting, presenting and analysing comparative findings on social context across all 12 Zambian study communities. The open/closed typology gave some indication of more/less resistance to interventions. Overall, the analysis allowed us to understand how more visible features of context might pull participation, response and uptake one way or another and identified which features were the difference that made the difference (see Table 4).

The BBS data fitted into the meta-indicator frame does not provide detail on HIV risk and sexual behaviour and the nuances of stigma. That would require a finer analysis of BBS data and more in-depth qualitative and ethnographic research. This analysis therefore only partly reveals contextual reasons. The influence of actual intervention delivery and aspects of data collection which may also influence the quantitative process indicators are not explored in this analysis. And there may be other explanations (epidemiological, contextual and other) for the differences in uptake observed between the communities. Future work is needed to explore if the features of difference, identified in this exploratory analysis of a limited number

Table 4. The difference that makes a difference – meta-indicators, open/closed typology.

Meta-indicator	Significant features of difference
Physical features	How porous a community is, the proximity to a town centre and an international border, the presence of industry, population size, type of housing, proportion of middle-class, the informal economy
Social organisation	Distribution of population across housing options, young men's work patterns, the link between informal livelihood and mobility, the presence/absence of HIV stakeholders over time
Networks	Social capital, community action, open/closed nature of networks
Narratives	The "hunch" and "feel" of a place

of study communities and drawing on a limited set of process indicators, hold up over the entire intervention period, all intervention communities and, perhaps, resound with statistical analysis of the differences between communities.

As a proof of concept, combining contextual insights on heterogeneity with quantitative data on HIV intervention uptake does highlight some key influences on how communities are similar and different and in what way and why this might matter to HIV interventions and research. Zarowsky et al. (2013) make an appeal, echoed by local systems and urban planning theory (Jacobs, 1961; Meadows & Wright, 2008) and social anthropology (Seeley, 2014; Wallman et al., 2011), to use both social change and "systems thinking" to understand vulnerability and capability in the face of crisis and transitions. It is this systems approach that inspired this line of inquiry to more broadly understand HIV intervention response and in the process make context count more comprehensively and explicitly.

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References

Bond, V. (2011). Terrains and tuberculosis: The model applied in urgent public health settings. In S. Wallman, V. Bond, M. Montouri, M. Vidali, & R. L. Conte (Eds.), *The capability of places: Methods for modelling community response to intrusion and change* (pp. 80–110). London: Pluto Press.

Bond, V., Hoddinott, G., Musheke, M., Viljoen, L., Abrahams, K., Chiti, B., … Seeley, J. (2013). *Broad Brush Surveys of HIV Prevention, Treatment and Care in 21 Zambian and South African Communities to prepare for HPTN 071 (PopART)*. Technical Report submitted to 3ie. Zambart, DTTC, LSHTM.

Hayes, R., Ayles, H., Beyers, N., Sabapathy, K., Floyd, S., Shanaube, K., … Watson-Jones, D. (2014). HPTN 071 (PopART): Rationale and design of a cluster-randomised trial of the population impact of an HIV combination prevention intervention including universal testing and treatment-a study protocol for a cluster randomised trial. *Trials, 15*(1), 57.

Jacobs, J. (1961). *The death and life of great American cities*. New York: Vintage.

Kosko, B. (1993). *Fuzzy Thinking, The new science of fuzzy logic*. London: Flamingo.

Meadows, D. H., & Wright, D. (2008). *Thinking in systems: A primer*. Hartford: Chelsea Green.

Murray, E., Marais, B., Mans, G., Beyers, N., Ayles, H., Godfrey-Faussett, P., … Bond, V. (2009). A multidisciplinary method to map potential tuberculosis transmission "hot spots" in high-burden communities. *The International Journal of Tuberculosis and Lung Disease, 13*(6), 767–774.

Porta, M. (Ed.). (2014). *A dictionary of epidemiology* (6th ed.). Oxford: Oxford University Press.

Seeley, J. (2014). *HIV and East Africa: Thirty years in the shadow of an epidemic*. London: Routledge.

Sismanidis, C., Moulton, L. H., Ayles, H., Fielding, K., Schaap, A., Beyers, N., … Hayes, R. (2008). Restricted randomization of ZAMSTAR: A 2×2 factorial cluster randomized trial. *Clinical Trials, 5*(4), 316–327.

Stringer, J. S., Chisembele-Taylor, A., Chibwesha, C. J., Chi, H. F., Ayles, H., Manda, H., … Williams, F. B. (2013). Protocol-driven primary care and community linkages to improve population health in rural Zambia: The Better Health Outcomes through Mentoring and Assessment (BHOMA) project. *BMC Health Services Research, 13*(Suppl. 2), S7.

Vermund, S. H., Fidler, S. J., Ayles, H., Beyers, N., Hayes, R. J., & HPTN 071 Study Team. (2013). Can combination prevention strategies reduce HIV transmission in generalized epidemic settings in Africa? The HPTN 071 (PopART) study plan in South Africa and Zambia. *Journal of Acquired Immune Deficiency Syndromes, 63*(02), S221–S227.

Wallman, S. (1984). *Eight London households*. London: Tavistock.

Wallman, S. (1996). Ethnicity, work and localism: Narratives of difference in London and Kampala. *Ethnic and Racial Studies, 19*(1), 1–28.

Wallman, S. (2003). *The diversity of diversity: Implications of the form and process of localised urban systems*. The Fondazione Eni Enrico Mattei Note di Lavoro Series Index. Retrieved from http://www.feem.it/web/activ/_wp.html.

Wallman, S., Bond, V. A., Montouri, M. A., Vidali, M., & Conte, R. L. (2011). *The capability of places: Methods for modelling community response to intrusion and change*. London: Pluto Press.

Zarowsky, C., Haddad, S., & Nguyen, V.-K. (2013). Beyond "vulnerable groups": Contexts and dynamics of vulnerability. *Global Health Promotion, 20*(1 Suppl.), 3–9.