# Health Worker Engagement and Facility Performance in Delivering HIV Care in Tanzania

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## Abstract

**Introduction:** With an increasing number of HIV-patients in treatment, a productive health workforce is essential to provide quality care. Engaged health workers are more productive and provide higher quality care. This study examined latent characteristics of engagement, factors that influence engagement, and the association with health facility performance in providing HIV care in Tanzania.

**Methods:** Engagement data were collected from 1329 health workers; facility-level data were collected from 183 facilities across six Tanzanian regions. We used factor analysis and structural equation modelling to examine latent characteristics of engagement and influencing factors and generalized linear modeling to assess the association between engagement and facility performance.

**Results:** We identified four latent characteristics of engagement (job satisfaction, being accountable, being a team player, and delivering equitable care) and three factors influencing engagement (supportive supervision, human resources and infrastructure, and competencies). All four engagement characteristics were associated with facility performance. Every 10% increase in the proportion of health workers with job satisfaction was associated with 1-percentage point decline in HIV patients lost to follow-up. A 10% increase in those delivering equitable care was associated with 1.8-percentage-point increase in HIV patients lost to follow-up. When more than 40% of health workers were accountable, every 10% increase was associated with 2.8-percentage-point decline in the proportion of HIV-exposed children on co-trimoxazole during their first two months of life. Every 10% increase in the proportion of health workers considered team players was associated with 1-percentage point decrease in the proportion of HIV patients screened for tuberculosis and 3.2-percentage point decrease in HIV patients checking CD4 counts every six months. Facility type and ownership, perceived presence of quality improvement teams, and staffing also influenced facility performance.

**Conclusions:** Engagement is a complex concept affected by health worker and health system factors. Interventions to improve job satisfaction, a characteristic of engagement, can positively impact facility performance. Facility performance cannot be improved through engaged workers alone and should be coupled with approaches to address gaps beyond human resources.

**Keywords:** Human resources for health; Health worker engagement; Job satisfaction; Performance; Quality of HIV care; Tanzania

## Introduction

As of 2016, the United States President's Emergency Plan for AIDS Relief (PEPFAR) was supporting 11.5 million people on essential antiretroviral therapy (ART) [1]. Meeting this demand requires an effective health workforce, especially in the face of increasing health worker (HW) shortages [2]. The PEPFAR 3.0 Human Resources for Health (HRH) strategy emphasizes the importance of HRH who are supported and retained [3]. Meeting the global 90-90-90 goal depends on an effective and adequate workforce [4-6], while insufficient HRH can exacerbate the impact of the HIV epidemic [7].

In 2015, Tanzania's HIV prevalence was 4.7% among adults age 15-49 [8]. With 6,876 health facilities, Tanzania needs an estimated 145,454 HWs to provide quality services. However,

only 63,447 HWs are available, resulting in a 56% shortfall. The existing health workforce is insufficiently trained to deliver HIV care; only 56% of facilities have a staff member trained in HIV counselling and testing, and 54% of facilities offering ART services have staff trained [9]. Tanzania's 2014-2019 HRH strategic plan's vision is to have a diverse and motivated workforce capable of delivering quality care [10].

An engaged workforce can be more productive and provide quality care, mitigating the impact of staffing shortages. Motivation is the internal strength to inspire action and contributes to job satisfaction [11,12]. Engaged workers have "a sense of energetic and effective connection with their work activities and they see themselves as able to deal well with the demands of their job" [13] and perform better and more productively [14,15]. Increased engagement among nurses results in improved patient satisfaction, better retention, higher morale, lower avoidable mortality and complication rates, and improved clinical measures [16]. Positive relationships have been reported between employee engagement and performance measures including customer loyalty, productivity, and patient safety [14]. Engagement is also related to reduced absenteeism and turnover [15].

There is a lack of research on employee engagement in low-resource contexts and its implications for performance in providing HIV services. Understanding how different dimensions of engagement relate to performance can help tailor interventions to build a high-performing workforce and accelerate coverage of quality HIV services.

## Methods

Data presented were part of larger mixed methods, cross-sectional study examining HW engagement and its relationship with performance and HW retention.

### Sample

All 310 public, private, and not-for-profit facilities in six purposively selected regions (Dar es Salaam, Morogoro, Iringa, Mtwara, Tabora and Kigoma) were stratified into types (tertiary hospital, referral hospital, clinic, health centre) and randomly selected. A minimum sample size of 783 HWs was required to achieve the power (0.8) to detect small effect size differences between groups (r=0.1) in HW engagement scores. HWs providing HIV services in care and treatment clinics (CTC), out-patient departments, laboratory, pharmaceutical services, and prevention of mother-to-child-transmission (PMTCT) services were invited to participate along with a quota of HWs who did not provide HIV services.

### Data Collection

Literature reviews and focus group discussions with a stakeholder consensus group produced constructs of HW engagement (Table 1) and factors influencing HW engagement (Table 2), informing draft study instruments. Surveys were developed in English, translated into Kiswahili, back-translated, and administered in Kiswahili.

Data collection tools included self-administered HW and facility surveys. The validated HW survey included 30 five-point Likert-type statements to assess engagement characteristics and possible factors influencing engagement, retention, and performance, and questions on demographics, length of employment, and intent to remain in their jobs (see additional file 1 and 1a). The facility survey gathered information from records on staffing, five HIV quality of care indicators, and three resource management indicators as dependent variables representing facility "performance" (see additional file 2 and 2a). Data were collected in February-April 2012.

**Data analysis**

We applied exploratory factor analysis (EFA) [17] to examine underlying characteristics of engagement using 1329 HW responses. Principal component analysis (PCA) [18], scree plot [19], and parallel analysis [20] were used to identify the number of factors to extract. We applied principal-axis EFA with promax rotation [21] to investigate items measuring latent characteristics. Factor loading and cross loading of each item on potential latent factors were tested for reliability using inter-item correlation. Confirmatory factor analysis (CFA) [21] was conducted using structural equation modelling (SEM) with least squares estimator [22] to validate that all characteristics identified in the EFA shared a common underlying construct – engagement. Goodness of fit statistics was compared to select the final model. Because HWs were nested within facilities, districts, and regions, we controlled for potential clustering effects. Goodness of fit statistics was used to select the final model.

To examine associations between engagement characteristics at the facility level and facility performance we used generalized

**Table 1:** Constructs and characteristics of health worker engagement

| Construct label *Kiswahili* | Characteristics |
|---|---|
| Accountable *Mwajibikaji* | • Responsible<br>• Reliable |
| Dedicated/Committed *Anayejituma* | • Devoted<br>• Loyal to organization<br>• Hardworking |
| Team player *Mshirika* | • Team builder<br>• Shares information<br>• Helps team members learn and perform |
| Professionalism *Mtaaluma* | • Treats patients with dignity<br>• Ethical<br>• Caring<br>• Good rapport with peers and clients<br>• Life-long learner<br>• Trustworthy<br>• Not corrupt |
| Involved/Empowered *Ushirikishwaji/ Mhusika* | • Feels there are clear goals and expectations<br>• Contributes to decision making processes<br>• Problem solves to address challenges |
| Motivated *Motisha* | • Willing to work<br>• Enthusiastic<br>• Job satisfaction |

**Table 2:** Factors influencing engagement

| Health worker factors | Work environment factors |
|---|---|
| • Attitudes to change<br>• Competency<br>• Self and client/community values and beliefs<br>• Feels accepted and valued by community and clients<br>• Feels accepted and valued by peers and management<br>• Professional expectations<br>• Recognition and reward<br>• Perceptions of career advancement opportunities<br>• Remuneration (adequacy, timeliness, fairness)<br>• Pension<br>• Perceptions of job security<br>• Work-life balance<br>• Family support<br>• Language barriers | • Task variety<br>• Workload<br>• Training<br>• Supervision, coaching and mentoring<br>• Presence of role models<br>• Adequacy of resources: health workers, equipment, supplies<br>• Infrastructure<br>• Management style<br>• Management effectiveness<br>• Commitment of decision makers<br>• Existence of policies and procedures<br>• Culture of continuous quality improvement<br>• Co-worker support<br>• Enforcement of rules, regulations and ethical code<br>• Accommodation<br>• Hiring process |

linear modelling (GLM). We measured performance using five indicators: 1) % of children born to HIV-positive mothers who started co-trimoxazole during their first two months of life; 2) % of HIV patients currently on antiretroviral therapy (ART) lost to follow-up (LTFU); 3) % of HIV patients at CTC screened for tuberculosis (TB); 4) % of HIV patients checking their CD4 count every 6 months; and 5) if CD4 services were not available due to dysfunctional machines or shortage of reagents in the past 30 days (a binary outcome). Key explanatory variables were HWs' engagement characteristics summarized at the facility level. We used the Bartlett method [23] to compute a numeric score that quantified each engagement characteristic for HWs as this method produces unbiased estimates of the true scores of latent factors, especially important when latent factors are used as predictors. We dichotomized each factor score using the mean so each HW could be categorized into high vs. low levels of engagement (e.g., high vs. low levels of job satisfaction). We summarized, in each facility, the proportions of HWs with high levels of job satisfaction and accountability, who tended to deliver equitable care, and who were more of a team player. We assumed participating HWs were representative of all HWs in each facility.

We used GLM with family binomial and link logit to estimate effects of engagement characteristics on care provision adjusting for clustering effects by region and confounding effects by individual-level and facility-level characteristics. Individual-level characteristics included sex, cadre, at least 16 years of experience as a HW, and at least five years providing HIV-related care--the average length of experience among participating HWs. Facility-level characteristics included facility type, management (% of HWs that believed a system existed to regularly monitor performance and % of HWs that believed a process existed for implementing improvements) and human resources (% vacancy by cadre).

Exploratory data analysis (EDA) was conducted to assess bivariate relationships between outcome indicators and engagement characteristics using scatter plots with Lowess smoothing techniques (continuous variables) and box plots (categorical variables). We used graphical displays and likelihood ratio tests to explore potential interactive effects between engagement characteristics and facility-level features. For outcomes that were proportions, we used robust variance estimation to account for continuous outcomes between 0 and 1. For the binary outcome, we used robust variance estimation to account for any potential misspecification of the models. The final model specification varied by outcome, and results of EDA and diagnostics tests informed the model selection. Model diagnostics were conducted by comparing deviance and Pearson residuals to predicted values and identifying highly influential points. In the final models, we estimated average marginal effects of engagement characteristics and other covariates on outcome indicators. We adjusted significant p-values from the final models using Bonferroni correction, Hommel'smethod, and Sidak's method [24]. Analyses were conducted in Stata/SE version 14.2 [25] and Mplus version 8.0 [22].

Ethical approval was granted by the University Research Co., LLC ethics review committee and the National Institute of Medical Research in Tanzania (NIMR/HQ/R.8a./Vol.IX/1284).

## Results

### Health worker and facility characteristics

The HW survey was distributed to 1330 HWs; 1329 surveys were included in analysis. Almost half (47%) of respondents worked in an out-patient department. Respondents offered diverse HIV services (Table 3). Over one-quarter (28%) received ART training in the previous year; 30% were trained in PMTCT in the previous year. Two-thirds were members of a quality improvement (QI) team. Over half were female (69%). Respondents had been providing HIV services for an average of five years.

Of the 183 participating facilities, most were reported as public health centres/dispensaries (70%), followed by public hospitals (12%) and private facilities (6%) (Table 4). On average, 44% of HWs believed their facility had a system to monitor performance indicators, and 74% believed their facility had a process for implementing changes. Approximately 60% of doctor and nurse positions were vacant.

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**Table 3:** Health worker characteristics

| Characteristics (categorical) | Health worker surveys % (N) | Total N |
|---|---|---|
| **Cadre** | | 1329 |
| Clinical officer, physician, assistant medical officer, medical officer | 22 (292) | |
| Nursing officer, assistant nursing officer, public health nurse, nurse midwife | 44 (580) | |
| Pharmacist, pharmacy technician, laboratory technician | 12 (160) | |
| Medical attendant | 16 (216) | |
| Other | 5 (68) | |
| Missing | 1 (13) | |
| **Region** | | |
| Dar es Salaam | 23.9 (317) | 1329 |
| Iringa | 13.8 (184) | |
| Kigoma | 9.6 (127) | |
| Morogoro | 20.4 (271) | |
| Mtwara | 13.5 (179) | |
| Tabora | 18.9 (251) | |
| **Perceived health facility type** | | 1301 |
| Public regional hospital | 9 (120) | |
| Public district hospital | 15.8 (210) | |
| Public health centre | 30.3 (403) | |
| Public dispensary | 22 (292) | |
| Faith-based organisation (FBO) hospital | 10.1 (134) | |
| FBO health centre | 3.7 (49) | |
| FBO dispensary | 2.2 (29) | |
| Private hospital | 3.4 (45) | |
| Private health centre | 0.8 (11) | |
| Private dispensary | 0.6 (8) | |
| **Gender** | | 1253 |
| Female | 68.9 (863) | |
| **Education** | | 1269 |
| Secondary school | 22.8 (303) | |
| Post-secondary/Non-tertiary | 54.2 (720) | |
| First stage tertiary (e.g., Bachelors) | 3.2 (43) | |
| Second stage tertiary (e.g., Masters) | 0.3 (4) | |
| Other | 15 (199) | |
| **Health services** | | 1329 |
| Antiretroviral therapy (ART) | 36 (479) | |
| Prevention of Mother-To-Child-Transmission (PMTCT) | 36.5 (485) | |
| HIV counselling and testing | 42.4 (563) | |
| HIV education | 34.5 (459) | |
| HIV registration | 27.2 (361) | |
| Out-patient department | 47.4 (630) | |
| Lab | 13.1 (174) | |
| Pharmacy | 11.3 (150) | |
| **Training** | | 1319 |
| Received ART training in past year | 27.6 (364) | |
| Received PMTCT training in past year | 30.1 (397) | |
| Received HIV counselling and testing training in past year | 26.7 (352) | |
| Received no training in past year | 36.2 (477) | |
| **Characteristics (continuous)** | **Mean (SD)** | **Total N** |
| **Age in years** | 41.7 (9.6) | 1209 |
| **Years worked** | | |
| Providing health services | 16.4 (11.5) | 1284 |
| Providing HIV services | 5 (4.2) | 1093 |
| In the current health facility | 7.8 (8.3) | 1307 |

%=percent frequency; N=absolute frequency; SD=standard deviation

**Table 4:** Facility characteristics

| | % (N) | Total N |
|---|---|---|
| **Perceived health facility type at facility level** | | |
| Public hospital | 11.6 (21) | |
| Public health centre/dispensary | 68.7 (125) | |
| FBO hospital | 5.5 (10) | 183 |
| FBO health centre/dispensary | 6.0 (11) | |
| Private health centre | 5.5 (10) | |
| Other | 2.8 (6) | |
| **Average bed capacity - Mean (SD)** | 62.4 (86.9) | 116 |
| **Perceived Quality Improvement (QI) measures** | | |
| Has system to monitor performance indicators | 43.5 (30.2) | 182 |
| Has process for implementing improvements | 74.4 (24.9) | 182 |
| Has a QI team which meets regularly | 79.2 (21.2) | 182 |
| **Human resources - % of positions vacant** | | |
| Physicians/ clinical officers/ assistant medical officers/ medical doctors | 59.6 (20.8) | 181 |
| Nursing officer or equivalent | 59.4 (22.8) | 179 |
| Pharmacist/pharmacy technician/ laboratory technician | 38.1 (34.4) | 181 |
| Medical attendants | 46.2 (21.4) | 182 |

%=percent frequency; N=absolute frequency; SD=standard deviation

### Latent characteristics of HW engagement

Results of PCA indicated that three factors could be extracted, with a possibility of a fourth and a fifth factors. The total variance explained by the three-, four-, and five-factor models was 50%, 56%, and 61%, respectively. After applying principal-axis EFA with promax rotation, the five-factor model presented clearer interpretability and better separation among the 21 items. In the five-factor model, one item on applying new skills was removed because of low loading on all factors (ranging from -0.06 to 0.37); another item on helping co-workers was removed because of its high cross loading on both Job Satisfaction (0.34) and Team Player (0.43) (Table 5). Reliability was tested; Cronbach's alpha for each factor is presented in table 6. All factors show reasonable Cronbach's alpha ranging from 0.55 to 0.75.

In CFA, the five-factor model on 19 items (excluding two items on applying new skills and helping co-workers, respectively) and the four-factor model (excluding the factor representing "professional ethics") on 15 items (excluding two items on applying new skills and helping co-workers, respectively) had the best fit with the lowest Root Mean Square Error of Approximation (RMSEA), high Comparative Fit Index (CFI), and Tucker Lewis Index (TLI) (Table 7), indicating further testing on items comprised of the last factor is needed to validate engagement as a latent construct. We used the four-factor model in the analysis of association between engagement characteristics and influencing factors because the four items representing "professional ethics" had high unique variances (ranging from 0.89 to 0.99), indicating these items may present some other underlying latent factors more than engagement characteristics.

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**Table 5:** Final five-factor model with factor loadings and unique variance (N=1152)

| Variable | Job satisfaction | Accountable | Deliver equitable care | Team player | Professional ethics | Uniqueness |
|---|---|---|---|---|---|---|
| I can interact easily with my co-workers | **0.7364** | 0.0867 | 0.0481 | -0.1152 | -0.005 | 0.4177 |
| I believe that all clients deserve to be treated respectfully | **0.6062** | -0.0739 | 0.3203 | -0.0215 | -0.0377 | 0.409 |
| I feel happy with work that I do | **0.7641** | 0.0407 | -0.1051 | -0.0747 | 0.0083 | 0.4879 |
| I am known by my coworkers for my reliability | **0.6494** | -0.0009 | 0.0732 | 0.1836 | -0.0022 | 0.4083 |
| I am proud to be a part of facility | **0.7542** | -0.025 | -0.0574 | 0.0626 | 0.0289 | 0.4444 |
| I prefer to give the same quality of care to all clients | -0.0242 | 0.0905 | **0.7877** | -0.0103 | -0.0594 | 0.3857 |
| I believe that my male and female patients deserve my equal attention | 0.1901 | -0.0421 | **0.6766** | 0.0774 | 0.0325 | 0.337 |
| The goals of my job are very clear to me | 0.0571 | **0.4724** | 0.0904 | 0.0214 | 0.059 | 0.6859 |
| I suggest solutions when discussing challenges with my co-workers | -0.03 | 0.1252 | 0.1098 | **0.5302** | -0.0473 | 0.5952 |
| I complete my tasks on time | -0.0345 | **0.6661** | -0.0208 | 0.0542 | -0.0365 | 0.5405 |
| I evaluate my own work performance | -0.0152 | **0.5085** | 0.0677 | 0.1641 | 0.0464 | 0.5849 |
| I stay on job until I complete my tasks | 0.0346 | **0.6378** | -0.0065 | -0.0047 | 0.0363 | 0.574 |
| I start at work early | 0.0304 | **0.7198** | -0.0163 | -0.0236 | -0.0543 | 0.4941 |
| I encourage my colleagues to discuss challenges | -0.0428 | 0.0575 | 0.0284 | **0.7242** | 0.0383 | 0.4214 |
| I give feedback to my co-workers on their performance | 0.0405 | 0.0414 | -0.0734 | **0.6671** | -0.0039 | 0.5309 |
| I do not think that my clients trust me | 0.1144 | 0.0813 | -0.1024 | 0.0233 | **0.6612** | 0.5379 |
| I believe that client privacy is not important | -0.0795 | -0.0477 | 0.1516 | 0.0091 | **0.7113** | 0.4302 |
| I find it difficult to have empathy for clients to whom I provide services | 0.0237 | -0.0132 | -0.2412 | 0.072 | **0.5529** | 0.7215 |
| I don't think there is anything wrong with asking clients for a small token before providing services | -0.0451 | -0.0011 | 0.228 | -0.1178 | **0.6113** | 0.5175 |

Note: Factor loadings greater than 0.4 were bolded.

**Table 6:** Reliability of constructed engagement characteristics (factor 1 to 5)

| Label | Cronbach's alpha | Items | Factor loadings |
|---|---|---|---|
| **Job satisfaction** | 0.75 | I can interact easily with my co-workers | 0.7364 |
| | | I believe that all clients deserve to be treated respectfully | 0.6062 |
| | | I feel happy with work that I do | 0.7641 |
| | | I am known by my co-workers for my reliability | 0.6494 |
| | | I am proud to be a part of facility | 0.7542 |
| **Accountable** | 0.69 | The goals of my job are very clear to me | 0.4724 |
| | | I complete my tasks on time | 0.6661 |
| | | I evaluate my own work performance | 0.5085 |
| | | I stay on job until I complete my tasks | 0.6378 |
| | | I start at work early | 0.7198 |
| **Deliver equitable care** | 0.55 | I prefer to give the same quality of care to all clients | 0.7877 |
| | | I believe that my male and female patients deserve my equal attention | 0.6766 |
| **Team player** | 0.65 | I suggest solutions when discussing challenges with my co-workers | 0.5302 |
| | | I encourage my colleagues to discuss challenges | 0.7242 |
| | | I give feedback to my co-workers on their performance | 0.6671 |
| **Professional ethics** | 0.59 | I do not think that my clients trust me | 0.6612 |
| | | I believe that client privacy is not important | 0.7113 |
| | | I find it difficult to have empathy for clients to whom I provide services | 0.5529 |
| | | I don't think there is anything wrong with asking clients for a small token before providing services | 0.6113 |

**Table 7:** Confirmatory factor analysis on one common underlying factor – engagement

|  | Model 1: using a 5-subfactor model on 21 items | Model 2: using a 5-subfactor model on 19 items (removing Apply New Skills and Help Coworkers) | Model 3: using a 4-subfactor model on 17 items (removing the last factor) | Model 4: using a 4-subfactor model on 15 items (removing Apply New Skills and Help Coworkers) |
|---|---|---|---|---|
| N | 1328 | 1328 | 1328 | 1328 |
| # of clusters | 6 | 6 | 6 | 6 |
| Fitness indices |  |  |  |  |
| RMSEA | 0.045 | 0.030 | 0.063 | 0.039 |
| CFI | 0.900 | 0.961 | 0.893 | 0.966 |
| TLI | 0.886 | 0.954 | 0.874 | 0.958 |

**Table 8:** Reliability of constructed influencing factors of engagement

| Label | Description | Cronbach's alpha | Items |
|---|---|---|---|
| Support from supervisor | Supervision | 0.7 | • Received feedback from supervisor<br>• Feedback<br>• Supervisor praises |
| Adequate infrastructure and human resources | Infrastructure and human resources | 0.67 | • Adequate infrastructure in facility<br>• Adequate employees<br>• Salary enough for basic needs<br>• Adequate equipment |
| Adequate work competencies | Knowledge and skills | 0.59 | • Knowledge available to do job well<br>• Skills available to do job well |

### Factors influencing HW engagement

Results of PCA on influencing factors of engagement indicated three underlying factors. Principal-axis EFA with promax rotation identified three factors that create a clear separation among the 9 items. No item had high cross loading or low loading on all factors. Reliability of the three factors was tested, and the Cronbach's alpha ranged from 0.59 to 0.7 (Table 8).

### Association between HW engagement and influencing factors

Goodness of fit statistics including RMSEA, CFI, and TLI of the final SEM model were 0.02, 0.98, and 0.97. We found that having more support from supervisors was associated with higher levels of job satisfaction, being accountable, being a team player, and a tendency to deliver equitable care (Table 9). Better infrastructure and more human resources were negatively associated with job satisfaction, being a team player, and delivering equitable care. Having adequate work competences were positively associated with all engagement characteristics.

### Health facility performance

Among patients visiting the 183 participating facilities, 72% of children born to HIV-positive mothers started co-trimoxazole during the first two months of life, and the LTFU rate among HIV-positive patients on ART was 15%. More than 75% of HIV-positive patients were screened for TB, and 61% checked their CD4 count every 6 months; 77% of facilities had no CD4 count services (Table 10).

The average proportions of HWs with high levels of job satisfaction and accountability were 48% and 45%, respectively (Table 10). Over 47% of HWs were team players, and 43% tended to deliver equitable care.

### Association between HW engagement and facility performance

All four engagement characteristics were found to be associated with one or more care performance indicators (Table 11). Specifically, every 10% increase in HWs satisfied with jobs was associated with 1-percentage point (95% CI: 0.3 to 1.6) decline in HIV patients LTFU, adjusting for all covariates. Delivering equitable care was also found to significantly affect LTFU, but in a different direction. Every 10% increase in the proportion of HWs who tended to deliver equitable care was associated with 1.8-percentage points (95% CI: 1.0 to 2.6) increase in LTFU; however, the magnitude of the effect was small.

When more than 40% of HWs were accountable, every 10% increase in the proportion was associated with a 2.8-percentage point (95% CI: 0.6 to 5.0) decline in the proportion of HIV-exposed babies on co-trimoxazole during their first two months of life (effect became insignificant after adjusting for multiple testing).

Being a team player defined as discussing challenges and solutions with colleagues and giving performance feedback to colleagues, negatively affected performance. Every 10% increase in the proportion of HWs considered a team player was associated with 1-percentage point (95% CI: 0.01 to 2.1) decrease in the proportion of HIV patients screened for TB (the effect was small and became insignificant after adjusting for multiple testing). This was associated with a 3.2-percentage point (95% CI: 1.0 to 5.4) decrease in HIV patients checking CD4 counts at least once every six months.

Facility infrastructure and QI measures were associated with performance. Adjusting for other covariates and engagement characteristics, public health centers/dispensaries, compared to public hospitals, had a significantly lower proportion of HIV

patients LTFU by 9.7-percentage points (95% CI: 0.8 to 18.5) and a significantly higher proportion of HIV patients screened for TB by 20.4-percentage points (95% CI: 2.1 to 38.8). Public health centres/dispensaries had a lower proportion of HIV patients checking CD4 counts every six months by 18.5-percentage points (95% CI: 0.7 to 36.3). These effects became insignificant after adjusting for multiple testing. Private facilities were estimated to have a lower likelihood of having no CD4 count services due to non-functional equipment or stockouts compared to public hospitals; effects became insignificant after adjusting for multiple testing. Compared to public hospitals, facilities that were not public, private, nor FBO-based had a 34.4-percentage point (95% CI: 20 to 49) increase in HIV patients screened for TB.

Every 10% increase in HWs that believed their facility had a system to monitor performance indicators was associated with a 1.6-percentage point (95% CI: 0.05 to 3.2) increase in HIV patients LTFU; the effects became insignificant after adjusting for multiple testing. Every 10% increase in HWs that believed a facility had a process for implementing improvement was predicted to reduce the proportion of HIV patients checked

for CD4 counts every six months; when more than 70% HWs believed such process existed, the effects reversed and increased HIV patients checked for CD4 counts by 11-percentage points (insignificant after multiple testing).

Having more female, experienced HWs, and a higher proportion of nurses seemed to improve HIV care. Every 10% increase in female HWs and HWs with five years of HIV experience was associated with a 1.5-percentage point (95% CI: 0.9 to 2.1) and 6.9-percentage points (95% CI: 4.3 to 9.5) increase in the proportion of children on co-trimoxazole, respectively. The positive impact became negative when the proportion of experienced HWs were greater than 30%. A similar pattern was found among those with more than 16 years of experience, which was associated with more HIV patients screened for TB until over 70% of HWs had more than 16 years of experience when the positive association was reversed.

Staff shortages also affected performance. Every 10% increase in medical doctor vacancy and nurse vacancy lead to a 3.3-percentage point and a 6-percentage point decreases, respectively, in the proportion of HIV-exposed children on co-trimoxazole. When more than 70% of nurse positions

**Table 9:** Association between characteristics of engagement and influencing factors of engagement adjusting for correlation within region (N=1328)

| | Estimate | S.E. | Est./S.E. | P-value |
|---|---|---|---|---|
| **Job satisfaction** | | | | |
| Support from supervision | 0.234 | 0.028 | 8.285 | 0.000 |
| Adequate infrastructure and human resources | -0.093 | 0.034 | -2.701 | 0.007 |
| Adequate work competencies | 0.437 | 0.029 | 15.063 | 0.000 |
| **Accountable** | | | | |
| Support from supervision | 0.272 | 0.037 | 7.273 | 0.000 |
| Adequate infrastructure and human resources | -0.056 | 0.057 | -0.999 | 0.318 |
| Adequate work competencies | 0.407 | 0.031 | 13.098 | 0.000 |
| **Deliver equitable care** | | | | |
| Support from supervision | 0.125 | 0.044 | 2.845 | 0.004 |
| Adequate infrastructure and human resources | -0.109 | 0.046 | -2.384 | 0.017 |
| Adequate work competencies | 0.339 | 0.026 | 13.084 | 0.000 |
| **Team player** | | | | |
| Support from supervision | 0.341 | 0.04 | 8.582 | 0.000 |
| Adequate infrastructure and human resources | -0.123 | 0.036 | -3.392 | 0.001 |
| Adequate work competencies | 0.376 | 0.055 | 6.834 | 0.000 |
| **N** | 1328 | | | |
| # clusters | 6 | | | |
| Fitness indeces | | | | |
| RMSEA | 0.019 | | | |
| CFI | 0.976 | | | |
| TLI | 0.971 | | | |

**Table 10:** Facility performance indicators and HW engagement

| | Mean (SD) | Total N |
|---|---|---|
| **Performance indicator** | | |
| % of children born to HIV-positive mothers who started on co-trimoxazole during their first two months of life | 72 (29.0) | 144 |
| % of HIV-positive patients on ART who are LTFU | 15 (18.2) | 151 |
| % of HIV-positive patients screened for TB when attending clinic | 75 (30.3) | 156 |
| % of HIV-positive patients from CTC who have their CD4 counts checked every six months | 61 (39.7) | 112 |
| % of facilities with no CD4 count services due to dysfunctional machine or reagent stockouts (% (N) | 77 (118) | 154 |
| **Health worker engagement** | | |
| % of HWs satisfied with job | 47.9 (26.8) | 182 |
| % of HWs accountable | 44.9 (26.1) | 182 |
| % of HW delivering equitable care | 43.6 (26.0) | 182 |
| % of HW as team player | 46.8 (28.3) | 182 |

**Table 11:** Associations between health facility engagement characteristics and performance in providing HIV care

| Variable in the models | Performance indicator 1: Change in % of children born to HIV-infected mother who started on co-trimoxazole during their first two months of life (N=142) | Performance indicator 2: Change in % of HIV-infected patients on ART who are lost to follow-up (N=148) | Performance indicator 3: Change in % of HIV-infected patients screened for TB when attending clinic (N=153) | Performance indicator 4: Change in % of HIV patients from CTC checking CD4 counts at least once every six months (N=111) | Performance indicator 5: Change in probability of having no CD4 count services due to dysfunctional CD4 machine or reagent problems (N=152) |
|---|---|---|---|---|---|
| **Latent engagement characteristics** | | | | | |
| % HW satisfied with job (per 10%) | 0.1 (-0.4, 2.1) | -1.0** (-1.6, -0.3) | 0.6 (-0.3, 1.5) | 0.2 (-2.3, 2.7) | 0.3 (-4.3, 5.0) |
| % accountable HW (per 10%) | ≤ 40% HW as accountable: 4.6 (-0.04, 9.2) | -0.7 (-2.0, 0.5) | 0.05 (-2.1, 2.2) | -0.2 (-2.2, 2.0) | 1.5 (-0.02, 3.1) |
| | >40% HW as accountable: -2.8* (-5.0,-0.6) | | | | |
| % HW delivering equitable care (per 10%) | 0.5 (-1.7, 2.7) | 1.8*** (1.0, 2.6) | -0.1 (-1.7, 1.5) | 0.1 (-4.0, 4.1) | 2.7 (-0.3, 5.7) |
| % HW as team player (per 10%) | -0.3 (-1.3, 1.2) | -0.4 (-2.1, 1.4) | -1.0* (-2.1, -0.01) | -3.2** (-5.4, -1.0) | 0.04 (-3.0, 3.1) |
| **Facility-level characteristics (only significant variables were presented)** | | | | | |
| Public health centres vs public hospitals | | -9.7* (-18.5, -0.8) | 20.4* (2.1, 38.8) | -18.5* (-36.3, -0.7) | |
| Private facility vs public hospital | | | | | -23.6* (-43.9, -3.4) |
| Other vs public hospital | | | 34.4*** (20.0, 49.0) | | |
| % HW believed a facility has system to monitor performance indicators (per 10%) | | 1.6* (0.05, 3.2) | | | |
| % HW believed a facility has process exists for implementing improvement (per 10%) | | | | ≤ 70%: -14.0*** (-20.2, -7.7) | |
| | | | | >70%: 11.3** (3.5, 19.1) | |
| **Human resource at facility level (only significant variables were presented)** | | | | | |
| % of female HW (per 10%) | 1.5*** (0.9, 2.1) | | | | |
| % of HWs providing HIV services for more than five years (per 10%) | ≤ 30%: 6.9*** (4.3, 9.5) | | | | |
| | >30%: -3.5** (-6.0, -1.0) | | | | |
| % of HWs providing health services for more than 16 years | | | ≤ 70%: 2.4 (-2.2, 7.0) | | |
| | | | >70%: -5.2** (-8.5, -2.0) | | |
| % of HWs as nurses (per 10%) | | | ≤ 70%: 1.9 (-0.2, 4.1) | | |
| | | | >70%: -6.0* (-11.9, -0.02) | | |
| % of HWs as medical doctors (per 10%) | -3.9*** (-6.0, -1.7) | | | | |
| % vacancy for nurses (per 10%) | <30% vacancy: 3.8 (-2.8, 10.5) | | | | |
| | 30-70% vacancy: -6.0** (-10.1, -1.9) | | | | |
| | >70% vacancy: 9.2*** (6.7, 11.6) | | | | |
| % vacancy for medical doctors (per 10%) | -3.3* (-5.9, -0.8) | 1.0* (0.02, 2.1) | | | |
| % vacancy for medical attendants (per 10%) | 1.8* (0.1, 3.5) | | | | |

**Note:** ***<0.001; **<0.01; *<0.05. The table only presents the variables that were found to be significantly associated with one or more outcome indicators for health facility performance. The empty cells indicate that the presented variables were not found to be significantly associated with the corresponding performance indicator. The numbers in the parentheses are the upper and lower bounds of the 95% confidence interval for the estimate.

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were vacant, incremental increases in vacancy led to a higher proportion of children on co-trimoxazole.

Results of model diagnostics indicated the model fit was fine for all outcome indicators. Adjustment of p-values due to multiple testing were consistent across different correction methods, and some covariates' effects (not presented above) became insignificant (additional file 3).

## Discussion

This study explored latent characteristics of HW engagement, factors influencing HW engagement, and the relationship between HW engagement and facility-level performance in the provision of HIV services in Tanzania. We identified four characteristics of HW engagement: job satisfaction, being accountable, being a team player, and delivering equitable care, highlighting the complexity of engagement. Research from Arusha, Tanzania, found only 20% of HWs could be characterized as abiding by accepted behaviours of one's organisation, including having knowledge, skills, and competence, while putting the interests of patients above personal needs [26]. This study revealed similarly low proportions of HWs embodying identified characteristics of engagement.

We identified three factors influencing engagement: supervisory support, human resources and infrastructure, and competencies. Previous studies found supervisor or management relations influenced engagement [27,28] and managers' action was the greatest determinant of nurse engagement [29]. Research from the Kilimanjaro Region found HWs felt an absence of supportive supervision and feedback to be demotivating [30]. Supportive supervision is an effective means of improving competencies [31,32], indicating these factors work in concert. In a survey of National Health Service staff in the United Kingdom, training and professional development as a means of improving competencies were the most important factors driving engagement [28]. Processes should be in place to ensure investments in training match job-related needs to build HW competence and confidence, and strengthen supervisors' relationships with staff.

Research suggests monetary compensation is a key motivating factor [33] and the absence of appropriate compensation can be demotivating [34]. Adequate salary, as a component of infrastructure and human resources, influenced engagement. Due to the intrinsic nature of many characteristics of engagement identified in this study, interventions to enhance engagement should include financial and non-financial incentives [35-37].

All four engagement characteristics were associated with facility performance in delivering HIV services. Job satisfaction was associated with reduced LTFU; delivering equitable care was associated with increased LTFU. HWs with higher job satisfaction may put in additional effort to locate patients who missed appointments. In contrast, HWs with tendencies to

provide equitable care may work in facilities with larger patient loads, making it difficult to trace and retain patients. This could be mitigated by shifting tasks among clinical staff, improving job satisfaction, morale, confidence, and quality of care [38]. More research is needed on staff utilization in differentiated care models and their relationship to engagement. The association between being accountable and HIV-exposed babies receiving co-trimoxazole was weak and insignificant after other testing, indicating further research on these relationships is necessary.

We found a negative association between being a team player and facility performance. Other research from Tanzania suggests working as a team facilitates quality HIV services [39], "reduce[s] emotional exhaustion", and minimizes burnout [40]. Our definition of team player focused on communication with colleagues, which, if excessive, may impact service delivery, accounting for the observed decline in TB screening and CD4 counts tested. More research is needed to explore how these elements interact.

Improving HW engagement cannot mitigate other aspects of the facility environment that impact care. Facility type and ownership, and staffing levels were associated with facility performance, consistent with other research [41]. HWs' perceptions that the facility had mechanisms for monitoring and improving performance had a negative association with facility performance. It is possible that HWs felt little personal responsibility for delivering comprehensive care when they perceived a system for improving care existed. Alternatively, respondent bias may have impacted responses.

Self-selection bias was negligible; data collectors did not report any instance of a HW or health facility declining to participate. Internal constructs of engagement are difficult to measure objectively or reliably, may change over time, and may not correspond to actual workplace behaviours. HWs may have responded in ways that reflect more favourable characteristics. The quality of records in some facilities may not reliably represent actual performance. These results need to be viewed in the context of an ever-changing HIV service delivery landscape in Tanzania as data were collected prior to implementation of Test and Start, impacting HW workload.

## Conclusions

HW engagement is a multifaceted construct comprised of characteristics influenced by supportive supervision, human resources, infrastructure, and competencies. Job satisfaction, being accountable and a team player, and providing equitable care are associated with facility performance in delivering HIV services, but in different ways, highlighting the complex relationship between engagement and performance. Facility performance in providing HIV care is also associated with health systems factors. Investments in well-supported HWs with high job satisfaction can improve engagement but should be coupled with efforts to address HRH shortages and infrastructure weaknesses for greater impact on performance.

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