

ORIGINAL ARTICLE

Feasibility and outcomes of integrating continuous quality improvement measures in infection prevention and control interventions at selected health facilities in Nairobi, Kenya during the COVID-19 pandemic, 2020 – 2021

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Abstract

Background: Infection prevention and control (IPC) programs are critical for safe, high-quality, and people-centered care. While the effect of IPC in averting Healthcare-associated infections (HAIs) is not in contention, the intervention models to promote IPC performance are little understood in developing countries such as Kenya. This study tested the feasibility of integrating continuous quality improvement (CQI) approaches in IPC measures and the resultant performance of IPC uptake in selected PEPFAR-supported health facilities in Nairobi, Kenya.

Methods: We conducted a baseline assessment (October 2020–December 2020) followed by quarterly assessments over 9 months (January 2021–September 2021) to assess the uptake of IPC practices upon implementation of IPC interventions through a CQI approach. The assessment was done in 49 health facilities in Nairobi, Kenya. The IPC interventions included the following: triage and screening; policies and training; supplies; Tuberculosis (TB) clinic measures; laboratory measures; injection safety; environmental cleaning; and device processing. Each of these interventions had specific activities that were tracked during the assessment. Specific CQI programs at each facility were developed to address gaps observed during baseline assessments, such as hand hygiene, healthcare worker screening, waste management, and triaging.

Results: All 49 facilities implemented interventions to improve IPC under a CQI program but only 40 had data available regarding CQI activities. During the assessment period, mean scores for all IPC domains increased across all 49 facilities. There were significant improvements across all domains with the highest improvements recorded in the domains of policies, coordination, and training (from 15 to 100%; $p < 0.001$), patient screening, and triage (45 to 100%; $p < 0.001$), TB clinic measures (38 to 86%; $p < 0.001$), and healthcare worker screening and triage (35 to 72%; $p < 0.001$).

Conclusion: IPC interventions, using a CQI approach, improved IPC mean scores substantially during the assessment period. Evidently, integrating CQI has an additive and significant effect on IPC uptake.

Keywords: *infection prevention and control; continuous quality improvement; safety; healthcare-associated infections; low- and middle-income countries; Kenya*

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To access the supplementary file, please visit the article landing page

A disproportionate amount of the global burden of infectious diseases remains in low- and middle-income countries (LMIC) (1). Among infectious diseases, healthcare-associated infections (HAIs) are a concerning problem with statistics depicting a cumulative incidence of 5.7 to 48.5% among hospitalized patients in sub-Saharan Africa (SSA) countries (2–5). High HAI rates result from suboptimal IPC programs, lack of adequately trained IPC professionals, inadequate IPC education, and poor compliance with IPC standard operating protocols and procedures, including hand hygiene. Prevention of HAIs is hinged upon sustained and integrated implementation of Infection Prevention and Control (IPC) measures (6–8). While the effect of IPC interventions on the reduction of HAIs is not in contention (9), what is less known is the intervention models that can boost the performance of IPC. This study aimed at assessing the effect of integrating CQI approaches on the overall performance of IPC interventions.

The World Health Organization (WHO) defines IPC as a set of practical, evidence-based approaches aimed at preventing harm to patients and healthcare workers due to avoidable infections (6). The benefits of IPC initiatives in reducing HAIs are indisputable yet LMIC experience significant and insurmountable hurdles to attain this goal (9). In SSA, IPC challenges related to inadequate hospital infrastructure, supply chain disruptions, and resource and workforce shortages have been reported (5, 10, 11). Routine implementation and monitoring of IPC interventions are often neglected, and their importance is only realized after outbreaks such as the COVID-19 pandemic (11).

The COVID-19 outbreak underscored the critical need for strengthened IPC interventions to safeguard both patients and healthcare workers (HCWs) (12). Despite this urgency, the implementation of IPC programs in most LMICs during the pandemic remained suboptimal (13). This highlighted the necessity to explore simplified approaches to IPC that can be readily adapted in practice. Integrating Continuous Quality Improvement (CQI) methodologies into IPC interventions has shown promise in enhancing IPC performance scores (14–16). However, in Kenya, there is limited understanding of how the integration of CQI measures impacts IPC performance within

health facility settings. To address this gap, we conducted an assessment to explore the feasibility and outcomes of integrating CQI interventions into IPC activities across 49 HIV care and treatment facilities in Nairobi County, supported by the University of Maryland at Baltimore (UMB) Program.

Methods

Study setting

This assessment was conducted across 49 health facilities in Nairobi with 27,648 clients on HIV and 1,719 on TB treatment at baseline. Among the 49 facilities, six were drop-in centers for key populations, 15 had high outpatient (OPD) workload of more than 15,000 per year, 10 had between 10,000 and 15,000 while the remaining 18 had OPD attendance below 10,000 at baseline. All 49 sites were under UMB support.

Design of the assessment

We conducted a baseline assessment between October 2020 and December 2020 followed by an end-line assessment, which was defined as the average score of the quarterly assessments of all the elements of the IPC domains over a 9-month period from January 2021 to September 2021 after the baseline. The aim was to gauge the improvement in IPC domains following the implementation of IPC activities and CQI interventions. We tracked the implementation period after the baseline, quarterly to assess the progress.

Intervention

We designed an integrated assessment tool (Supplementary Table 1) drawing from the WHO IPC readiness assessment framework (17), the Kenya TB IPC guidelines (18), and the IPC response capacity for COVID-19 health facility assessment tool adopted from the WHO-developed core assessment modules ‘Suite of health service capacity assessments in the context of the COVID-19 pandemic’ (19). The integrated IPC tool assessed the implementation of 39 IPC interventions that were grouped into eight domains and tracked over the intervention period. The domains comprised: triage and screening, policies and training, supplies, TB clinic measures, laboratory

biosafety, injection safety, environmental cleaning, and device processing (Table 1).

Each domain had several indicators that were tracked quarterly to compute the mean scores for each domain (Supplementary Table 1). We identified the county and sub-county IPC, TB, and laboratory coordinators, who were trained on the tool, and later used to conduct assessments. We then used the CQI approach to address the identified IPC gaps after the baseline assessment.

CQI implementing facilities followed the four significant steps of problem identification, root cause analysis, developing solutions, and the development of goal statements and objectives to generate change ideas based on the identified root causes as per the Kenya Quality Model for Health (KQMH) (15). The Plan-Do-Study-Act (PDSA) cycle was used to implement practical measures as guided by the KQMH guidelines. The data collected on the four types of CQI projects of hand hygiene, triage,

waste management, and HCW screening were captured using the CQI dashboard to show trends across the implementation period. While data collection was done across 49 facilities, only 40 (82%) had CQI data captured in the CQI platform for analysis.

At the national level, we supported the TB program to integrate COVID-19 IPC measures into existing TB IPC guidelines and training curricula (18). During the intervention period, these guidelines together with the WHO guidelines (6) were used to train a pool of trainers who cascaded the training to the facility HCW. We supported facilities to develop IPC work plans in response to identified gaps, reactivated IPC committees, and appointed facility-specific IPC focal persons (clinicians/facility managers) to coordinate the implementation of the IPC work plans. Facilities were further supported by monthly continuing medical education (CME) sessions, IPC review meetings, and quarterly supportive supervision visits by

Table 1. Operationalization of the IPC measures

No.	Domain name	Description
1.	Policy coordination and training	This assessed the proportion of the facilities with: IPC guidelines and policies, dedicated IPC focal persons, active IPC committee, approved procedures for screening and triage of patients and HCWs, training and educational materials on screening and triage, IPC work plans that address identified gaps during IPC audits and whether these plans were displayed.
2.	Patient screening and triage	This assessed the proportion of facilities with: 1). A designated space for screening and triage, 2). Staff to screen and triage patients, 3). Requisite supplies and equipment for screening and triaging patients, 4). Training and educational material on screening and triage, and 5). Performed active patient screening for COVID-19.
3.	HCW screening and triage	This assessed the proportion of facilities with designated staff to screen HCWs, designated space for screening and triage for HCWs, those with necessary supplies and equipment to screen HCWs, those with training and educational materials on screening of HCWs, and facilities that performed active HCWs screening for COVID-19.
4.	TB Clinic IPC measures	The domain measured the proportion of facilities with health talks on TB, COVID-19, and other respiratory infections given to waiting clients; facilities with patients screened for cough at the outpatient department (OPD); those with a separate area for presumptive TB and COVID cases; those carrying out screening of HCWs for TB; number of healthcare workers screened for TB in the last 1 year; and finally, the proportion of facilities with N-95 masks available and in use by staff in high-risk service areas.
5.	Laboratory Biosafety	This domain assessed the proportion of facilities with TB, COVID-19, and other respiratory diseases informational signage displayed; those with laboratory staff trained on General Laboratory Biosafety; those facilities with updated biosafety manuals/SOPs; those with adequate and appropriate PPE for laboratory staff; facilities with up-to-date certification of biosafety cabinet/hood; and lastly facilities with a final waste holding area.
6.	Injection safety	This domain assessed the proportion of facilities with aseptic techniques in use; those not recycling needles/syringes; those with sharps containers available; and lastly those with PPE protocols.
7.	Environmental cleaning and disinfection	This domain assessed the proportion of facilities with the following disinfections: chlorine 0.5 or 70% ethyl alcohol; those with evidence of daily preparation of bleach dilution; those with documented evidence of cleaning and disinfection of high-touch surfaces three times daily; and those practicing disinfection of patient care medical devices.
8.	Device reprocessing	Under this domain, we assessed the proportion of facilities with policies, procedures, and manufacturer reprocessing instructions for reusable medical devices; those with documented evidence of cleaning, reprocessing, and maintenance of medical devices as per manufacturers' instructions; facilities with SOPs that guide HCWs on how to confirm achieved sterility/disinfection and facilities discarding single-use devices.

county and sub-county teams. We supported facilities to create triage areas equipped for COVID-19 and TB screening and provided them with policies; guidelines; information, education, and communication materials; standard operating procedures (SOPs); minor facility structural improvements; and personal protective equipment (PPE).

Data collection

Data were collected at baseline (October 2020–December 2020) and then quarterly during the 9-month implementation period (January 2021 to September 2021). The average mean scores for the post-baseline assessments across the quarters were used as end-line scores. The end-line scores were compared to the baseline scores using odds ratios and associated *p*-values to assess any significant changes in IPC performance against the progressive implementation of CQI projects and IPC measures that were instituted to address the identified IPC gaps. Data collection was done jointly by trained county, sub-county, and UMB technical teams using KoBo collect® and entered into a web-based database for analysis. Data quality assurance was strengthened using in-built validation rules and checks in KoBo collect®.

Data variables

The first outcome of this assessment was the uptake of IPC interventions defined as the change in the eight IPC domain scores between baseline and end line of the integrated assessment tool. The end-line scores were defined as all the average scores of the quarterly assessments conducted after the baseline assessments for all the eight IPC domains. The second outcome was the implementation of CQI projects, which was measured as the proportion of facilities with CQI projects that were implemented continuously and reported monthly throughout the 9-month implementation period after the baseline period.

Data analysis

Using STATA version 16, we performed univariate analyses to describe the frequency of the assessment outcomes, deriving frequencies and proportions for binary outcomes. Chi-square and Fisher's exact tests, where applicable, were used to assess the difference between assessment results at baseline and subsequent quarterly periods. For parsimony, the baseline scores were compared with an average end-line score (the mean score for the three quarterly follow-up assessments after the baseline) to assess the changes in IPC performance since baseline. To assess whether the change in scores was statistically significant, we used the *cci* command in Stata 16.0 to compute the *p*-values of the point estimates of the baseline and end-line scores. A *p*-value of <0.05 signified a significant difference in the scores between the baseline and end line and vice versa. An elaborate explanation of the use of the *cci* command can be found on the following link: <https://www.stata.com/manuals/repitab.pdf>.

Results

Uptake of IPC interventions

At baseline, the mean scores of five out of eight domains assessing uptake of IPC interventions in 49 facilities were <50%, with the highest score being 81%. Overall, there was an increase in the uptake of interventions across the domains with an average score of 90% or more in five domains at the end line. The domain of policies, coordination, and training recorded the most improvement with a more than five-fold increase (from 15% at baseline to 100% at the end line). Generally, regardless of the baseline scores, all IPC domains evaluated increased by the end of the implementation period as shown in Table 2.

Table 2 shows an increase in injection safety (from 81% to 96%; *p* < 0.01) and laboratory safety measures (71% to 90%; *p* < 0.01). Further results (Supplementary

Table 2. Uptake of IPC interventions as measured by average domain scores between the baseline and end line, Nairobi County, October 2020 and September 2021

IPC domain	Baseline score N = 49 (%)	Qtr. 2 (%)	Qtr. 3 (%)	Qtr. 4 (%)	Mean Edline score (Qtr2-4) (%)	% point change (%)	<i>p</i>
1. Policy coordination and training	15	82	100	100	94	79	< 0.001
2. Patient screening and triage	45	92	99	100	97	52	< 0.001
3. Healthcare worker screening and triage	35	78	80	72	77	42	< 0.001
4. TB clinic IPC measures	38	73%	81	86	80	42	< 0.001
5. Laboratory biosafety	71	85	87	90	87	16	< 0.001
6. Injection safety	81	94	95	96	95	14	< 0.001
7. Environmental cleaning and disinfection	47	66	80	82	76	29	< 0.001
8. Devise reprocessing	72	91	93	96	93	21	< 0.001

Notes: each of these domains had several subdomains that were tracked on a quarterly basis. In total, 39 subdomains were being tracked during the project's implementation phase. A detailed performance score across all the subdomains is contained in Supplementary Table 1.

Table 1) show that under the domain of injection safety, the most significant improvement was observed in the availability of PPE protocols among laboratory staff, which was witnessed in the era of the COVID-19 pandemic (37% to 95.2%; $p < 0.01$). The rest of the interventions such as the use of aseptic techniques, nonrecycling of needles and syringes, and availability of containers for sharps already had high baseline scores with minimal need for improvements. The only significant improvement observed under the domain of laboratory safety interventions was the availability of signage for TB and COVID, which was intensified during the peak of the COVID-19 pandemic (20 to 91.8%; $p < 0.01$) as part of the preventive strategies. The rest of the domains under the laboratory safety (Supplementary Table 1) was in place right from baseline.

Uptake of integrated CQI interventions

While all the 49 target facilities collected data on CQI, only 40 (82%) were assessed in this study since nine facilities had missing data in the CQI dashboard. The number of CQI projects increased from 0 to 111, with the largest number of documented CQI projects initiated between October 2020 and January 2021, where a 53% increase in the initiation of CQI projects was observed. There was a stable performance from March to September 2021, where 40/49 (82%) of the facilities were actively implementing CQI projects.

Distribution of CQI projects

Out of the 49 facilities that were included in this assessment, nine did not report on the CQI online platform, eight facilities reported only one CQI project, 16 facilities had two CQI projects, 14 facilities had three, and seven

facilities had four CQI projects. Thus, a total of 111 CQI projects were implemented across 40 facilities by the end of the assessment (Fig. 1). As shown in Fig. 1, the number of facilities initiating CQI projects changed over time in response to the COVID-19 pandemic. For instance, the number of health facilities that initiated CQI projects on HCW screening increased from three to 40 between January 2021 and September 2021.

The CQI projects that aimed to prevent the spread of COVID-19 measures gained prominence over the period. For instance, in December 2020, we did not have any CQI projects on hand hygiene, and only two projects focused on HCW screening and one on triage. However, by January 2021, 23 CQI projects on hand hygiene were instituted and implemented, four on triaging and three on HCW screening. As more cases of COVID-19 were recorded among HCWs and the general population, the projects on HCW screening measures increased from 3 to 40 between January 2021 to September 2021.

Discussion

The assessment findings showed that it is feasible to improve the uptake of IPC interventions by integrating CQI interventions into IPC measures. This integration had an additive effect on the overall improvements in IPC interventions. The uptake of CQI projects by facilities increased significantly between the baseline and end term. Past studies have shown that CQI approaches result in improved IPC interventions (14, 15). Other studies have shown that CQI triggers the implementation of a package of interventions, resulting in improvement of health outcomes. Overall, all the domains of IPC improved over time during the assessment period as the number of facilities increasingly initiated CQI projects. It is likely

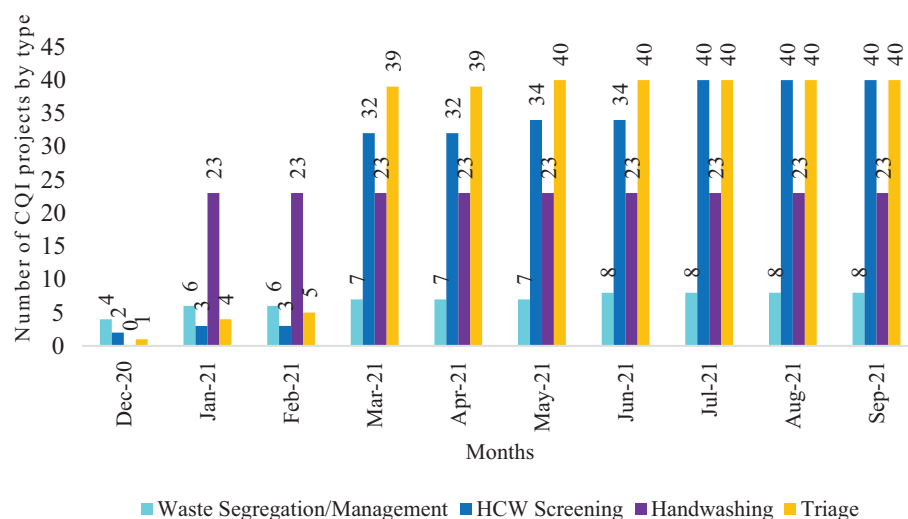


Fig. 1. Distribution of integrated IPC project domains by month, December 2020–September 2021 ($N = 40$ facilities, 111 projects).

that the upsurge in measures such as increased patient screening and triage, hand hygiene, and increased use of PPEs was triggered by the upsurge in COVID-19 cases during the assessment period. This increase in IPC interventions is imperative as it has been demonstrated that IPC is one of the most effective and cost-saving interventions available in health programming (4, 20, 21).

The highest improvements in IPC uptake were recorded in the domains of policies, coordination and training, patient screening and triage, TB clinic, and healthcare worker screening and triage. These results partly mirror those of a Ugandan assessment, which identified the lack of training and sensitization and the absence of standard operating procedures as barriers to increased uptake of IPC interventions that targeted integration of TB screening with COVID-19 prevention measures (22). A detailed assessment of the components for injection safety and laboratory biosafety found that almost all the requisite measures including the use of aseptic technique, nonrecycling of needles and syringes, and the availability of sharp containers were all in place at baseline resulting in marginal changes by end line as shown in Supplementary Table 1.

The low uptake of HCW screening in this assessment may have been influenced by lack of screening facilities and stigma that was associated with screening positive for COVID-19. A second pulse assessment conducted by WHO found that only a third of primary health facilities and a quarter of hospitals had screening facilities for COVID-19 pandemic (12). The assessment also found a shortage of PPE with only 20% of primary facilities and 27% of hospitals having all the requisite screening items available for implementation of a COVID-19 safe environment. Similarly, an assessment done in Uganda found that HCW screening was negatively impacted by limited knowledge and reluctance to screen for fear of stigmatization (22). This assessment revealed that the majority of the CQI projects focused on HCW screening since this was identified as low at baseline, yet high transmission of COVID-19 during the assessment period necessitated the need to strengthen HCW screening. Past studies also found HCW screening and screening of the general population to be critical in IPC (2, 4, 6, 7, 9, 11, 21).

The findings from this evaluative study give credence to the feasibility of integrating CQI strategies into IPC interventions. Effective IPC interventions are regarded as fundamental in-patient safety and in health system strengthening (6). The emergence of pandemics such as COVID-19 implies that effective IPC interventions are not only important but also urgent and should be sustained past the pandemic period. There is indisputable evidence that effective IPC interventions may combat HAIs and antimicrobial resistance and prevent disease outbreaks (6).

The CQI initiatives that increase IPC interventions can help lower the risk of acquiring HAI and provide a safer work environment for HCWs. Sustaining these gains is thus crucial to ensuring long-term patient safety and minimizing HAIs. For this to happen, it is crucial to allocate adequate resources for training, equipment, and infrastructure related to infection control (21). To address the differences in attitudes and practices between different departments, such as between the laboratory and other departments, continuous interprofessional education and teamwork are necessary to improve compliance with IPC guidelines. In addition, implementing a robust monitoring system through standardized indicators and regular assessments, as well as strong leadership within healthcare institutions is necessary (7, 21). This multifaceted approach will ensure a safer healthcare environment for everyone.

The contribution of this study

Our review shows that past studies have by and large focused on the effect of IPC interventions on HAIs, but little attention has been paid to strategies on improved performance of IPC. This study addresses this gap by demonstrating the synergistic effect of integrating CQI approaches into IPC interventions.

Assessment limitations

The paper did not assess the widely known associations between IPC programs and reduction of HAIs. Rather, our attention in this study was to assess the integration of CQI interventions on the overall performance of IPC interventions.

Conclusion

The CQI approaches can improve IPC performance. It is therefore feasible to integrate CQI strategies into IPC interventions. This integration has a synergistic effect on the resultant IPC performance scores. Additionally, findings from this study point out that the use of qualitative methods could be beneficial to investigate the barriers to HCW screening that resulted in poor uptake of COVID-19 screening.

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Ethical approval

The assessment was approved by the AMREF Ethics and Scientific Review Committee (AMREF-ESRCP1022/2021) and the University of Maryland, Baltimore Institutional Review Board (HP-00098491). The assessment protocol

was also reviewed as per the U.S. CDC human research protection procedures and was determined to be nonresearch.

Conflicts of interest and funding

The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection and analyses, or in the decision to publish the results. This assessment was supported by the U.S. Centers for Disease Control and Prevention (CDC) with funding from the Coronavirus Preparedness and Response Supplemental Appropriates Act, 2020 and the President's Emergency Plan for AIDS Relief (PEPFAR) through cooperative agreement NU2GGH001962.

Disclaimer language

The findings and conclusions in this paper are those of the authors and do not necessarily represent the official views of, not an endorsement by Centers for Disease Control and Prevention, PEPFAR, or the U.S. Government.

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