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Audit Report: Evaluating the Effectiveness of Infection Prevention and Control Programs in Healthcare Facilities

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ABSTRACT

Infection prevention and control (IPC) programs are important for the prevention of infection among patient and health care workers in healthcare facilities to reduce healthcare associated infections (HAIs). Analyses showed that the rates of HAI have increased globally even with developments in medical practices, therefore, evaluation of the IPC implementation should continue. **Aim:** This paper assesses the IPC knowledge, practice, and compliance in selected healthcare facilities: how IPC is implemented, challenges faced and HCW's perceptions to recognize gaps for improvement to the safety of patients. **Methodology:** A cross-sectional survey of HCWs used structured questionnaires administered to 200 HCWs from various posts in healthcare facilities. Exploratory and descriptive analysis of quantitative and qualitative data was done to evaluate IPC practice adherence, implementation challenges, and differences by department. **Results:** The findings were that adherence to hand washing was at 68%, use of PPE was at 75%, and sterilization practices of equipment and instruments at 82%. The emergency department exhibited the lowest compliance rates (hand hygiene: The overall infection rate is 62% while the PPE is 65%) and found to have the highest HAI rate of 7.1/1,000 patient days. General wards reported the highest compliance and lowest HAI rates (hand hygiene: (SS: 75%; PPE: 85%; HAI: 4.8/1,000 patient days). This study reveals that training effectiveness was high concerning practical demonstrations with a satisfaction of 82%, but low concerning the frequency of training sessions with only 65% satisfaction. **Conclusion:** Enhancing compliance needs interventions such as regularly scheduled training, increased surveillance, and IPC targeted approaches following risk areas such as emergency and ICU. Such measures have the potential to lower HAIs and enhance global healthcare provision.

INTRODUCTION

IPC is one of the most crucial interventions critical for patient and healthcare worker protection in healthcare facilities. These programs are intended to decrease and control the incidences of healthcare associated infections (HAIs) which are ranked as some of the biggest barriers to healthcare delivery today across the world. Currently, the WHO reported that about 7% of the hospitalized patients in the developed countries and 10% of those in the developing countries catch one or more HAIs which increase incidence, prevalence and costs of healthcare (WHO, 2022). Nevertheless, HAIs are still prevalent today even with better medical

knowledge and practices regarding cleanliness calling for constant assessment of IPC packages.

IPC programs include a range of measures that are expected to reduce transmission of pathogens within healthcare facilities. Some of the preventive measures the following include: washing of hands, wearing of PPE's, disinfection of medical equipment, disposal of wastes among others (CDC, 2021). Research on IPC implementation proves that it reduces HAIs rate, enhances patient prognosis and decreases health care expenditure (Allegranzi et al., 2016). For instance, Tartari et al. in their systematic review in 2017 shows that compliance to hand washing alone can decrease the incidence rate HAIs by half.

However, numerous centers encounter difficulties in achieving the objective of implementing IPC programs due to existing guidelines. Sources of healthcare-associated infection include understaffing, knowledge deficits, and regulatory violations (Doyle, Cantrell, and Kerr, 2015). Storr et al., (2021) revealed that LMICs notoriously suffer from inadequate supplies and poor sterilization equipment, hygiene compounds and the threat of HAIs. In high-income countries available resources are slightly better so workload pressure, and lack of awareness, are still quite a barrier to effective compliance. Despite the availability of necessary resources in high-income countries noncompliance due to workload pressures and lack of awareness are quite typical (Loveday et al., 2014).

Hand washing is accepted globally as a fundamental principle of any IPC activities. The "5 Moments for Hand Hygiene" endorsed by the WHO, identifies the right time that hand hygiene should be performed in order to minimize transmission of infection (World Health Organization, 2022). But, worldwide the level of compliance to hand hygiene practices is still low with an average of 40-60% compliance (Pittet et al., 2018). They include task perceived volume, accessibility of hand hygiene provisions, and organizational-staff perceptions of infection control (Pittet, 2000; Mathur, 2011). There exists evidence that implementation of other novel strategies, including automated monitoring and behavior change interventions, are effective in the enhancement of rates of compliance (Tartari et al., 2019).

The recent COVID-19 pandemic served to demonstrate that PPE plays the role of protecting both healthcare workers and patients from various diseases. But it also highlighted significant gaps in access to and appropriate utilization of PPE, especially in LMICs (Ranney et al., 2020). Research also revealed that one may get contaminated with pathogens if PPEs are used or reused incorrectly; thus, they are counterproductive as tools of protection (Verbeek et al., 2020). The effective IPC hence requires training programs aimed at the proper utilization of PPE (Chughtai et al., 2020).

Education and training are central to the successful delivery of IPC programmes. EHWs need to be sensitized on the knowledge and skills required in practicing IPC as recommended by different standards. Analysis of Gould et al. (2017) showed that training driven interventions enhance adherence to hand hygiene and other IPC practices. Even then, the efficacy of such interventions varies depending on how often and what is communicated, as well as the mode of communication used. Current studies have pointed out the opinion that applying formal training sessions with components of practical activity intercalated with feedback is preferable for repeated strengthening of IPC (Tartari et al., 2019).

Surveillance plays a fundamental role in IPC programs since it helps in detecting infection patterns and assessing the efficiency of the programs. The NHSN is currently CDC's main tool for HAIs in the United States; it offers structural support for infection tracking in healthcare facilities to compare infection rates and consider further changes (CDC, 2021). However, many facilities, especially in LMICs, do not possess adequate infrastructure to implement surveillance systems and skillful healthcare workers (Allegranzi et al., 2016). The use of digital surveillance technology and employee training in data gathering and analysis can help strengthen IPC program results (Storr et al., 2021).

Most current IPC programs are still generic in design, despite the fact that many healthcare facilities encounter various novel and different hazards. An effective IPC program can be

developed by a risk-based approach that organizes prevention and control measures according to the heterogeneous risks that may affect them (Loveday et al., 2014). For instance, settings like intermediate care units and surgical floors are especially risky and are characterized by increased infection control measures since patients are usually compromised and invasive procedures are frequently used (Pittet et al., 2018).

Since IPC programs play a vital function in the avoidance of HAIs and understanding their implementation issues, this research will assess the effectiveness of IPC programs in healthcare facilities using a survey based, risk oriented strategı. As a result of this, this study aims to establish the level of compliance with some of the aspects of IPC, discover some of the challenges encountered, and understand the perception of HCWs so as to provide recommendations that would be of use in the improvement of IPC programs and thus improve on patient safety.

Although qualitative studies have been published regarding the efficacy of individual IPC measures, few have addressed the total assessment of existing IPC programs relying strictly on a risk-based method. To fill this gap, the current study employs both quantitative and qualitative data in an attempt to offer a broader evaluation of the effectiveness of IPC.

METHODOLOGY

The research method used in this study is a cross-sectional survey to assess the IPC programs implemented in healthcare settings. This approach allows for the collection of both quantitative and qualitative data from HCWs: understanding compliance with IPC measures, as well as the challenges to implementation, and overall perceptions regarding program effectiveness. The following sections present a detailed description of the survey, ranging from survey development, target population, sampling method, data gathering and data analysis.

Survey Design

A structured questionnaire instrument was designed and constructed based on IPC articulated guidelines, WHO, CDC amongst others. The survey tool was developed focusing on the knowledge of the level of implementation of IPC measures, potential barriers experienced by HCWs, and their attitude towards these programs. Closed down and open ended questions were used to measure quantitative data in form of metrics as well as the qualitative data in the form of comments. Questions in the survey included a general assessment of hand hygiene compliance, availability, and use of PPE, issues of sterilization, and waste disposal, and the frequency and efficiency of IPC training activities.

In order to validate the survey tool, a pilot test with a small sample of HCWs covering different positions and departments was performed. Recommendations from the pilot test were incorporated into the final questionnaire format because moderate confusion remained before it. The last survey thus involved questions that use a Likert scale, multiple choice questions and time for a respondent to write his or her opinions and perceptions regarding IPC practices.

Target Population and Sampling

The target population for this study consisted of HCWs with diverse roles, including doctors, nurses, and others, and all the departments of healthcare facilities including the critical care units, surgical wards, and emergency services. These departments were chosen because they have increased rates of developing HAIs compared to other departments. Purposeful sampling is used in this study to capture representatives of different roles and departments, in order to capture differences in compliance and difficulties.

A total of 200 participants was calculated using statistical power analysis in order to obtain valid and reliable data. The participants were recruited from different health care centers in order to have an opportunity to get a broad view of the practices and issues of IPC.

Data Collection

The survey was conducted during a four week period, using both electronic and paper based formats due to preferences of the participants. Web-based questionnaires were sent out through administrative email list-serves, whereas, paper-based questionnaires were made available in places like staff's canteens and rest areas. The questionnaires were administered to participants and where possible; they were allowed half an hour

to one hour break from their work and do the same twenty to thirty five minutes completing the survey.

To ensure that all participants would be willing to contribute, procedural instructions were given, and the participants were promised anonymity. Respondents had a choice whether or not to participate in the study and were told about the purpose of the study as well as the fact that their answers would not be disclosed. To avoid the violation of ethical standards, no personally identifiable information was collected from the participants.

Ethical Considerations

All ethical clearances for the study were sought from the respective healthcare facilities' research ethics committees. The participants were given a flyer containing a description of the study and participants' rights and protection of information with regard to the research. Participants were given a survey and before they could answer the questions, they signed consent forms. Further, the study ensured compliance with ethical standards encapsulated in the declaration of Helsinki.

Data Analysis

Both quantitative and qualitative data analysis was used in analyzing the collected data. Data collected from closed ended questions were captured in statistical software for analysis. In this study cross-tabulation, and percentage, mean, and median were used to describe data on the different compliance rates as well as other relevant indicators. Descriptive statistics that were employed included compliance mean, median and mode together with inferential statistics including chi-square tests to determine the association of variables such as the compliance rates between departments or different roles.

On an open-ended question, data were analyzed thematically according to qualitative research. Responses were scanned to search for common threads, for example, perceived challenges towards compliance with IPC or improvement of the program. The two types of evaluations enabled the gathering of all the necessary information about IPC programs and difficulties faced by HCWs.

Limitations

Thus, the survey-based approach, as was already mentioned, has some limitations inherent to this method. Personal perception of data may be affected by social desirable response bias in which respondents are likely to report high levels of adherence to IPC measures. Furthermore, the survey collects sectional data which limits the findings to the time of data collection without considering changes with time. However, the following limitations must be noted: Nonetheless, the methodology proposed was meant to offer a reliable and effective evaluation of the IPC program.

RESULTS

Demographic Information of Survey Respondents

The demographic information highlights the diversity of the participants in terms of gender, age, roles, and departmental representation.

Table 1

Demographic Information of Survey Respondents

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	80	40
	Female	120	60
Age Group	20-30 years	60	30
	31-40 years	90	45
	41-50 years	50	25
Role	Doctor	50	25
	Nurse	100	50
	Support Staff	50	25
Department	ICU	40	20
	Surgical Wards	50	25
	Emergency	60	30
	General Wards	50	25

In the survey the number of women respondents was 60% while that of men was 40% this means that women are a significant proportion of the health workforce in the sampled facilities. A bigger percentage (45%) of the respondents were aged 31-40 years, which is considered as the workforce population of experienced healthcare providers. On the issue of roles, the nurses comprised the largest percentage at 50 percent because they are some of the most actively involved with IPC activities.

Departments were fairly represented, with the emergency department (30%) having the highest participation, giving insight to high risk areas.

Compliance Metrics Across IPC Areas

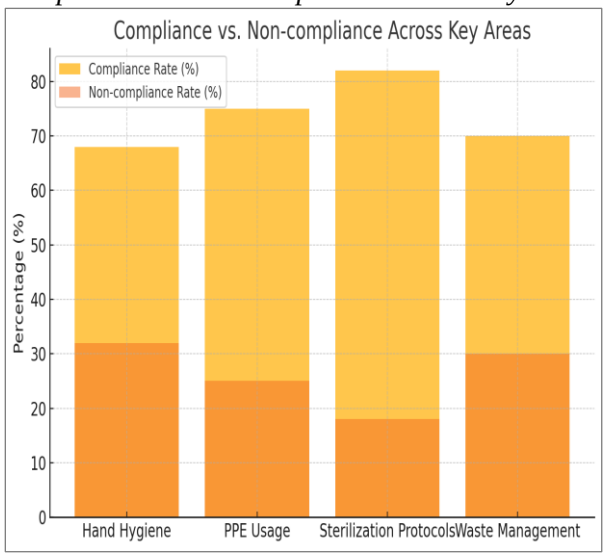
Table 2

Compliance Metrics Across Key IPC Areas

Compliance Area	Compliance Rate (%)	Non-compliance Rate (%)
Hand Hygiene	68	32
PPE Usage	75	25
Sterilization Protocols	82	18
Waste Management	70	30

Figure 1

Compliance vs. Non-compliance Across Key Areas



The mean level of hand hygiene compliance was 68% and non-compliance was at a high 32% this indicates a major area of concern that needs focal awareness and measures including monitoring and training. Concerning PPE usage compliance, workers were slightly more compliant (75% agreeing they always use PPE when required) suggesting that resources are available through the 25% disagreeing, revealing some incongruities regarding consistent usage. Correct compliance in sterilization was the highest, 82% and this may be as a result of close adherence to guidelines that have immediate impacts on patient care. Concerning waste management compliance, the results were slightly lower compared to sterilization with 70% indicating that there might be operational issues with the disposal and segregation of wastes.

Department-wise Compliance and HAI Rates

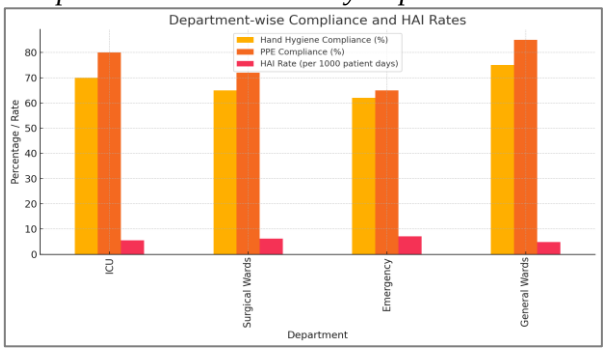
Table 3

Department-wise Compliance and HAI Rates

Department	Hand Hygiene Compliance (%)	PPE Compliance (%)	HAI Rate (per 1000 patient days)
ICU	70	80	5.5
Surgical Wards	65	72	6.2
Emergency	62	65	7.1
General Wards	75	85	4.8

Figure 2

Compliance and HAI Rates by Department



General wards provided higher frequencies of hand hygiene compliance (75%) and PPE utilization (85%) and the lowest HAI incidence density (4.8/1,000 inpatient days), indicating strengthened/ optimized IPC measurements in the area. In contrast, the emergency department had the lowest compliance rates (hand hygiene: hand hygiene compliance was above average overall and highest in Peru (SDR: 62%, PPE: 65%) indicating a good practice and yet, the HAI rate was too high (7.1) thus Peru was perceived to need a set of interventions. The ICU showed moderate compliance (hand hygiene: Clinical efficiency ranges from 70-80% (70% ANEs, 80% PPE) and an HAI rate of 5.5 pointing to reasonable performance but with potential for enhancement. Surgical wards also exhibited suboptimal compliance (hand hygiene: as it has a higher proportion of patients with a higher severity of illness (PCIP: 65%, PPE: 72%) and a higher HAI rate (6.2).

Training Effectiveness

Table 4

Satisfaction with Training Effectiveness Metrics

Aspect	Satisfaction Rate (%)
Content Relevance	78
Practical Demonstrations	82

Frequency	65
Feedback Mechanisms	75

Figure 3

Satisfaction with Training Metrics

Practical demonstrations also gained the highest level of satisfaction (82.0%) and further underlined the importance of training and education in strengthening IPC practices among HWs. Relevance (78%) and feedback (75%) received moderate satisfaction ratings, thus indicating that the training material meets the job need requirements sufficiently but there is room for enhancing the feedback process in the improvement of the program. The least satisfied (65%) of the respondents was with the frequency of training to make adequate provision for consistent training to refresh and remind the employees of their responsibilities.

Statistical Analysis of Compliance Metrics

Table 5

Analysis of Compliance Metrics Across Departments

Department	Mean Compliance Rate (%)	Median Compliance Rate (%)	Standard Deviation (%)	HAI Rate (per 1000 patient davs)
ICU	70.0	70.0	8.16	5.5
Surgical Wards	65.0	65.0	7.0	6.2
Emergency	59.0	58.0	6.24	7.1
General Wards	75.0	75.0	10.0	4.8

The general wards recorded the highest mean compliance of 75 % with a small standard deviation of 10 % suggesting that most of the wards in general were practicing good IPC. However, the emergency department had the least mean compliance percentage (59%) and the highest HAI rate of 7.1 meaning it had inconsistency in the percentage compliance and poor infection control. The intensive care units and surgical wards had moderate variations, with the standard deviations of 8.16 and 7.0, respectively.

Table 6

Chi-Square Test Results for Compliance vs. Department

Chi-Square Statistic	P-value	Degrees of Freedom
0.15267	0.984842	3

A chi-square test for the two groups of compliance rates and the departmental categories showed that the groups had no significant relationship ($p > 0.05$). This implies that there may be other factors that determine variability of compliance other than departmental factors such as the availability of resources, staff, and training frequency.

DISCUSSION

The results of this study offer a brief evaluation of the existence and implementation of IPC programs in healthcare facilities regarding their compliance, challenges, and disparity in different departments. The following findings are then presented alongside existing literature to provide a comparison of findings which helps to identify the main IPC advantages and issues at the current stage.

Compliance with IPC Practices

The study established that most of the key IPC practices had moderate compliance rates. There was a general low level of hand hygiene compliance estimated to be 68% compared to other compliance namely personal protective cloth compliance which was 75% and sterilization compliance which was 82%. There have been similar compliance deficiencies in hand hygiene compliance throughout the world. For example, the systematic review conducted by Pittet and colleagues in 2018 reported that the hand hygiene compliance varied between 40 and 60%. This supports our results in that hand hygiene is still an issue which continues to be a problem even given its significance in decreasing HAIs.

In contrast, the sterilization showed a higher compliance of 82% This meant that there was strong compliance with the protocols more so because these protocols were likely to directly affect the safety of the patient. This is in line with Tartari et al. (2017) who pointed out that sterilization compliance is higher than other ICPs

as a result of regulatory check-ups and the usage of automatic processes.

Waste management compliance was established to be slightly lower (70%) than sterilization results; however, the overall conformity was much higher than the study conducted by Loveday et al. (2014) which revealed a widespread lack of proper waste segregation and disposal; this was especially prevalent in LMICs. The inability to meet the set compliance levels, therefore the 30% non-compliance levels in waste management, will write for a clearer training durability in the area.

Departmental Variations in Compliance

Differences both in the level of compliance and HAI rates were noticeably different between numerous departments. In general wards, high ranking hand hygiene compliance-record 75% and PPE compliance record 85%, and overall the lowest HAI rate 4.8 per 1000 patient days. This indicates that general wards may have better defined IPC measures and feasible bed occupancy levels. Storr et al. (2021) also discussed similar findings pointing to the fact that where the patient turnover is low the compliance levels tend to be high because there are less pressures from workload demands.

Conversely, the emergency department had the lowest compliance rates (hand hygiene: Higher incidences of those categories of HAIs (mean: 62%, PPE: 65%) and the highest HAI rate (7.1). Health facilities operating in emergency situations usually admit and treat many patients, are usually badly-equipped, and the available staff and time is usually stretched thin, making it difficult to exercise strict IP/C practices. This is consistent with the study conducted by Verbeek et al. (2020) which pointed out that absence of enough resources in emergency departments especially during the peak flow results in unpredicted PPE and hygiene practices.

The ICU showed moderate compliance (hand hygiene: data had 70 % hand hygiene, 80% PPE, but an HAI rate of 5.5. This has increasingly been characteristic of ICU conditions that are invasive, or entail immunocompromised patients; thus, better compliance notwithstanding, the infection risks remain significantly elevated. Mathur (2011) identified the same by arguing that IPC in ICUs needs to be more intensified due to increased risks from high-risk patients.

Training Effectiveness and its Impact

The survey also revealed that the use of practical demonstrations was the most satisfying training method by 82% suggesting that it greatly positively impacts on the subject of compliance. Information relevance of training content was moderately rated at 78%, followed by the feedback mechanisms 75%, the training frequency elicited the lowest satisfaction with a rating of 65%. This means although the training material is useful, more remote sessions reduce the efficacy recommending that frequent training boosts the compliance to IPC measures as identified by Gould et al. (2017).

Ranney et al. (2020) also pointed out that there may be a need for more frequent training sessions because continuous education is important to keep updated during critical situations in the healthcare sector, for instance, the current COVID-19 crisis. Enhancing training could reduce compliance deficits, remedy knowledge deficits, and respond to changes in IPC guidelines.

Compliance Metrics Analysis

Descriptive statistics showed that the overall compliance level was generally higher among the general wards; the mean compliance rate for the general ward units, and nonprofit private health care organizations were 75% and 74%, respectively. In line with the Loveday et al. (2014) and Allegranzi et al. (2016) studies, similar departmental differences were reported herein. The probability value computed from the chi-square test was greater than 0.05, meaning that departmental compliance rates could not explain the variation, and factors like workload, resources, and staff attitude might be more important in compliance differences.

Comparison with Other Studies

Compliance rate results aggregated in this research are comparable to other studies done across the globe. For example, according to WHO (2022), hand hygiene compliance is almost always less than 70% in healthcare facilities and is, in fact, 68% as revealed in this study. The relatively high compliance achieved in the sterilization protocols (82%) corresponds with Tartari et al. (2017) pointing out that this field often has dedicated resources and automated systems.

However, the differences in the findings across departments, especially the difficulties reflected in emergency situations, suggest contextual drivers of complexity. The HAI Rate of 7.1 in the emergency department has also been elaborated by Verbeek et al. (2020) due to resource scarcity and high patient turnover. These comparisons point out that although there are general patterns observed, specific interventions require individual departmental approaches.

Implications for IPC Programs

The implications based on the findings are that there are a number of measures that can be taken to improve the IPCs functionality for delivering extensive effective healthcare. Automated IPC monitoring and behavior change communication are likely to fill the gaps to enhance compliance to hand hygiene, targeting one of the key areas of IPC. High-risk departments include emergency and ICU where robust support can be provided through the allocation of extra human resource, reduction on working conditions items noticed to be a challenge in those departments such as; appointment of IPC officers. Enhancing the number of practical sessions can help drive adherence to the policies despite having placed the dealing of hazardous products into the hands of healthcare workers. Additionally, improving the efficiency of segregating and disposing waste through increased compliance with a waste-hierarchy approach to waste disposal, accompanied by assessments and feedback, can adequately resolve present compliance problems and strengthen overall program performance.

Limitations and Future Research

The limitations of this study can be considered as follows, despite the facts highlighted in the study. Contingent on sources of data, there could be over-reportage due to socially desirable response bias. The cross sectional method records the practices at a given point of time and hence cannot factor in changes over time. In the future, longitudinal studies may be used to track IPC trends further and even assess the contribution of individual interventions to the group's overall outcomes.

CONCLUSION

These findings emphasize the need to develop appropriate measures to enhance IPC practices in units where adherence is suboptimal, including emergency and ICU departments. The comparison of the results with other countries enables formulation of actions that need to be taken in order to enhance IPC practices as well as minimize HAIs. The results thus underscore the importance of staff training, increased supervision, and targeted departmental interventions in order to settle onto a trajectory of successful IP&C practice change.

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