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Improving infection prevention practices through a novel safety coaches' program

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ABSTRACT

Background: Healthcare-associated infections (HAIs) contribute to extended hospital stays and heightened in-hospital mortality rates. Effective infection prevention and control (IPAC) strategies are crucial for curtailing infection rates. The COVID-19 pandemic amplified disease burdens, compelling rigorous preventative measures. Mackenzie Health introduced the IPAC Safety Coaches Program to bolster adherence to IPAC guidelines and mitigate HAIs.

Methods: IPAC Safety Coach training transpired over three iterative cohorts of educational sessions. Each session comprised a review of new learning material, discussion of key topics, and mandatory action items. Primary outcomes focused on hand hygiene and proper donning/doffing of personal protective equipment (PPE). Secondary outcomes focused on *Clostridioides difficile (C. difficile)* and central line associated bloodstream infection (CLABSI) rates. Data were collected using a standardized audit reporting form.

Results: Across three training cohorts, improvements were noted in key compliance metrics: hand hygiene compliance improved by 6%, approaching statistical significance. Significant improvements were observed in PPE donning (16%), and PPE doffing (17%) compliance. Secondary outcomes demonstrated substantial reductions in *C. difficile* (55%) and CLABSI (57%) rates across the three cohorts.

Conclusion: The novel IPAC Safety Coach Program led to improvements in hand hygiene, PPE donning and doffing compliance, and contributed to reduced *C. difficile* and CLABSI infection rates.

KEYWORDS
Patient safety, infection control, quality improvement

INTRODUCTION

Infection prevention and control (IPAC) is a public health initiative led by a multidisciplinary team aimed at preventing the spread of infections, enhancing survival rates, and reducing infection-associated morbidity in diverse healthcare settings (PIDAC, 2012). IPAC initiatives play a crucial role in controlling the spread of healthcare-associated infections (HAIs), which represent the most common adverse outcome across global healthcare systems (Lowe *et al.*, 2021; WHO, 2010). In Canada, it is estimated that more than 200,000 individuals acquire HAIs annually, a number that appears to be on the rise (PHAC, 2013). Patients affected by HAIs experience lengthier hospital stays and heightened in-hospital mortality rates (Gidey *et al.*, 2023; Stewart *et al.*, 2021). These infections impose substantial financial burdens on healthcare systems, patients, and their families, contributing to at least 8,000 preventable deaths in Canada annually (PICNet, n.d.).

Reducing HAIs requires comprehensive, interdisciplinary, and multifaceted IPAC strategies across various healthcare settings. Key strategies include promoting proper hand hygiene, safe donning and doffing of personal protective equipment (PPE), and maintaining rigorous cleaning practices (CDC, 2022). Common barriers to achieving IPAC outcomes include inconsistent adherence to hand hygiene protocols, and inadequate knowledge of cleaning procedures, underscoring the need for targeted training programs (Gambeta & Chambers, 2021; Dekker, Jongerden, *et al.*, 2022; Dekker, van Mansfeld, *et al.*, 2022; NHS, 2023; PHO, 2022). These training programs are most effective when frontline workers are actively engaged in IPAC, and when individual team members are empowered to take on leadership roles as IPAC safety coaches (Hilken *et al.*, 2017; Amir Yeganeh, S., & Lee, C., 2023; NHS, 2023).

With the onset of the COVID-19 pandemic in Ontario in March 2020, IPAC efforts focused on reducing infection

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transmission in community and healthcare settings, promoting more rigorous preventative practices (PHO, 2022). In response to the increased burden of disease, our health system implemented the IPAC Safety Coaches Program, aiming to promote IPAC best practices and prevent the spread of infections among patients, staff, and visitors. The primary goal was to improve hand hygiene and PPE use, while the secondary goal was to decrease HAIs. This article presents an overview of the design, implementation, and outcomes of the novel IPAC Safety Coaches Program.

METHODS

Setting

Mackenzie Health is a large community hospital serving a population of more than half a million Ontario, Canada. Its 667 beds are divided between two sites: Richmond Hill and Cortellucci Vaughan (opened in February 2021). The hospital includes 63 critical care beds and 56 alternative level of care beds. The remaining inpatient beds are distributed among medical, surgical, mental health, pediatric, and obstetrical care units.

Interventions

The IPAC Safety Coaches Program was introduced at Mackenzie Health in March 2021, aiming to empower and educate frontline staff in IPAC practices, increase compliance with IPAC guidelines, and decrease HAIs. The program was led by two infection control practitioners and delivered through a series of structured one-hour weekly educational and interactive sessions over a six-month period (21 sessions). Each session began with a 'safety starter' sharing a patient story with opportunities for improvement and learning, followed by new material, a review of previous material, a discussion period, and mandatory action items for the next session. The training covered focused and comprehensive IPAC topics, and provided tools to support proactive IPAC practices and decision-making. These included education on infectious disease processes, additional precautions, appropriate PPE use, isolation measures, and steps to take in the case of exposure. The session topics are outlined in Table 1 and a sample session agenda is included in Appendix A (see online edition).

Participants were tasked with completing action items during their regular clinical time, aiming to transfer knowledge and empower other staff to advocate for safe IPAC practices. These included conducting audits, sharing what they learned during staff huddles, and performing environmental scans of their units. Participants were also encouraged to voice any concerns or questions for group discussion. Formal feedback was collected to facilitate iterative improvements to the sessions.

Sessions were delivered virtually, with PowerPoint slides and notes shared with all participants. To successfully complete the program, participants were required to attend a minimum of 30% of the sessions and 100% of post-session action items. Participation was encouraged from frontline staff members across various departments within the organization. Unit managers were selected as IPAC safety coaches based on their written expressions of interest. There were no exclusions based on seniority of position, however, the program aimed to foster a bottom-up effect on change, focusing on leaders and unit managers. Physicians were not included in these initial cohorts.

TABLE 1: MACKENZIE HEALTH IPAC SAFETY COACHES CURRICULUM

Session	Curriculum Topic
Session 0	Orientation
Session 1	Introduction
Session 2	PPE Part I
Session 3	PPE Part II
Session 4	Hand Hygiene
Session 5	COVID-19 Part I
Session 6	COVID-19 Part II
Session 7	Review and Questions and Answers
Session 8	Respiratory Infections and IPAC practices
Session 9	IPAC and the Healthcare Environment
Session 10	Patient and Family Education on Infection prevention
Session 11	Electronic Medical Record Documentation
Session 12	Rehab Therapy
Session 13	Outbreak Management
Session 14	Safety Reporting
Session 15	*C. difficile* and Gastroenteritis
Session 16	Antibiotic Resistant Organisms
Session 17	Chickenpox, Shingles, and Monkeypox
Session 18	Tuberculosis
Session 19	Measles
Session 20	Group A *Streptococcus*
Session 21	Meningitis and Conjunctivitis

PPE – Personal Protective Equipment; IPAC – Infection prevention and control

Measures

The primary outcome measures for implementation of this project were hand hygiene and PPE donning/doffing compliance. Hand hygiene compliance was defined as completing of any of the four moments of hand hygiene, observed and recorded through a formal audit process. These four moments include: (1) before initial patient/patient environment contact; (2) before an aseptic procedure; (3) after body fluid exposure risk; and, (4) after the patient/patient environment contact (Public Health Ontario, n.d.). Audits could focus on any of these moments, depending on the patient interaction, with the majority of audits conducted on moments (1) and (4) due to the less frequent occurrence of aseptic procedures and body fluid exposure.

PPE donning and doffing was defined as completion of *all* outlined steps (based on type of isolation) in the correct order (PHO, n.d., 2020). Secondary outcome measures, selected prior to project initiation, included two potential HAIs: *Clostridioides difficile* (*C. difficile*) infections, and central line associated bloodstream infections (CLABSIs). These HAIs were selected due to their frequency, standardized definition, measurement, and validation (Safer Healthcare Now, 2012; Public Health Ontario, 2013)).

Data collection

Data on hand hygiene and PPE donning and doffing compliance were gathered using a standardized audit form. Hand hygiene was assessed separately from PPE donning and doffing.

Initially, audits were completed by the IPAC team. As each cohort completed the standardized training, new safety coaches were added to the auditor pool. Each unit was required to completed a minimum of 30 audits of hand hygiene and PPE donning and doffing, respectively each month, based on feasibility. Audits were conducted randomly during regular shifts, with each safety coach responsible for auditing their own units. To mitigate potential Hawthorne bias, audits were completed without clinical staff being made aware. Data were collected from across the organization's inpatient wards, including medical, surgical, and critical care wards. Data were also collected from non-inpatient settings such as the Emergency Department, Medical Imaging Area, and the Dialysis Unit.

Data analysis

Run Charts were generated using QI Macros (Version 2018.04; KnowWare International, Inc., Denver, Colorado) for Microsoft Excel (Microsoft Corporation, Redmond, Washington; version 14.5.9). Pre- and post-intervention groups were compared using a two tailed Mann-Whitney U test (statistical significance $p<0.05$). This quality improvement study with a before-after design received exemption approval from the Southlake Regional Health Centre Research Ethics Board.

TABLE 2: PARTICIPANTS BY OCCUPATION ACROSS ALL COHORTS

Occupation	Percentage of Participants
Nurse	42%
Pharmacy	8%
Allied Health	13%
Unit Secretary	17%
Nurse Educator	5%
Wound Care Specialist	1%
Environmental Associate	6%
Medical Imaging	2%
Administration	6%

***Total number of participants was n=101, percentages approximate the absolute numbers of participants**

Nurse: Registered Nurse, Registered Nurse Practitioner, Patient Care Assistant, Patient Care Coordinator Pharmacy: Clinical Pharmacist, Pharmacy Technician Allied Health: Respiratory Therapist, Service Assistant, Physiotherapy Assistant, Child Life Specialist, Transporter Environmental Associate: Medical Device Reprocessing Technician, Environmental Associate Medical Imaging: Medical Imaging Technologist, Radiation TechnologistAdministrative: Occupational Health and Safety, Patient Access Representative, Health Information Specialist

RESULTS

Participants and cohorts

The first, second, and third cohorts comprised 53, 46, and 33 participants who signed up and attended at least one session. Among them, 53% (n=28), 56% (n=26), and 61% (n=20) successfully completed the program, meeting the required 30% weekly session attendance and 100% completed action items. Participants varied by occupation, with the majority being nursing staff as outlined in Table 2. The first cohort was trained from April 5, 2021 to September 13, 2021, followed by the second cohort from November 22, 2021 to April 25, 2022, and the third cohort from October 6, 2022 to March 23, 2023.

Primary outcomes

Through the implementation the IPAC Safety Coaches Program, hand hygiene compliance started at 85% (n=3518; over 4 months) at baseline. Compliance increased to 88%

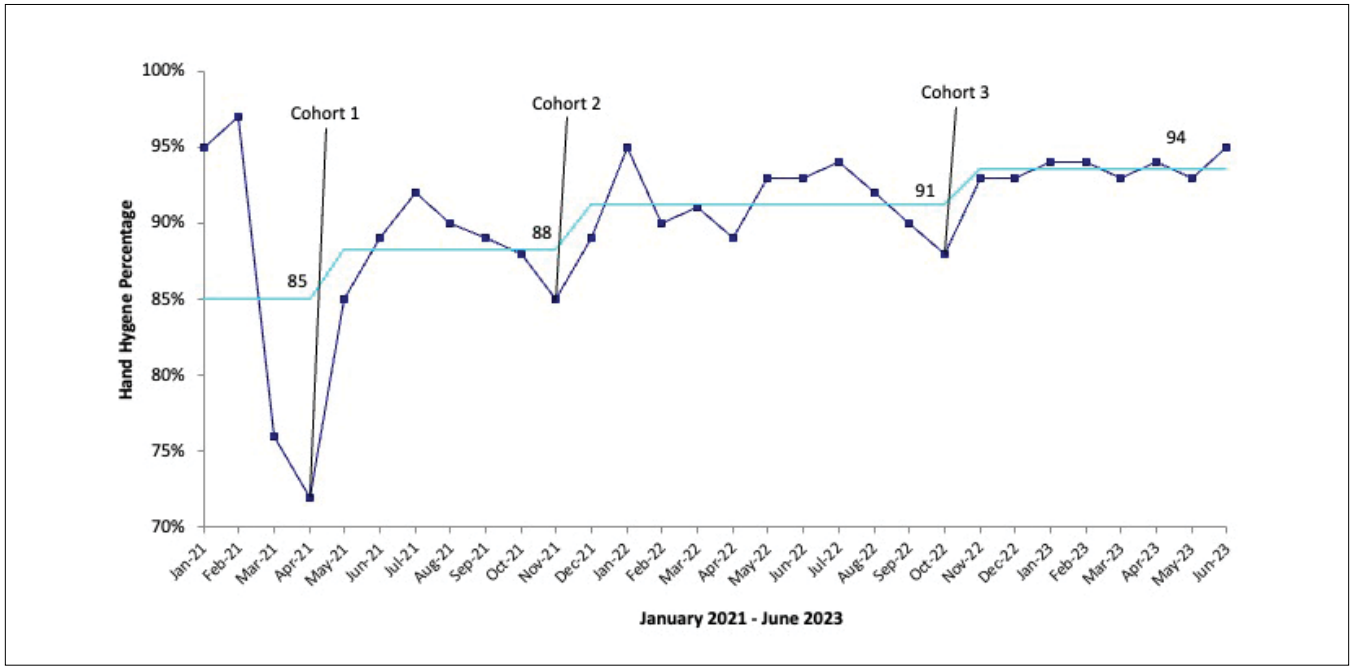

Figure 1: Hand Hygiene Run Chart across IPAC Safety Coaches Program

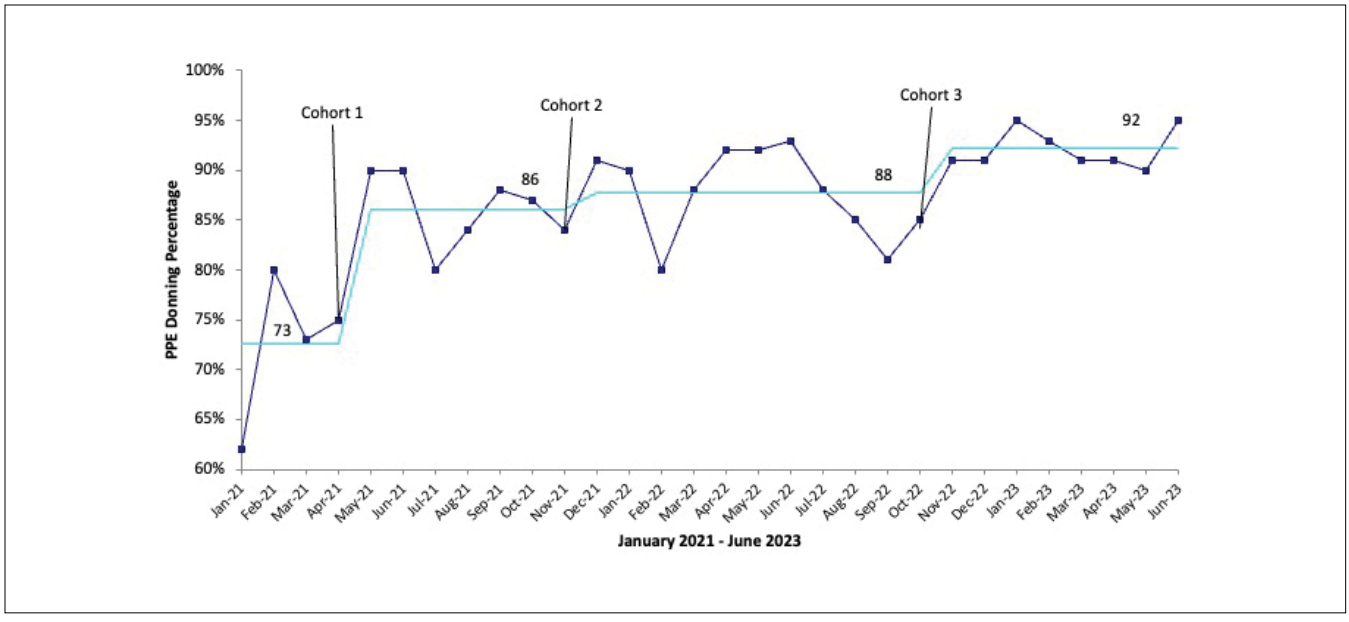

Figure 2: Personal Protective Equipment Donning Run Chart across IPAC Safety Coaches Program

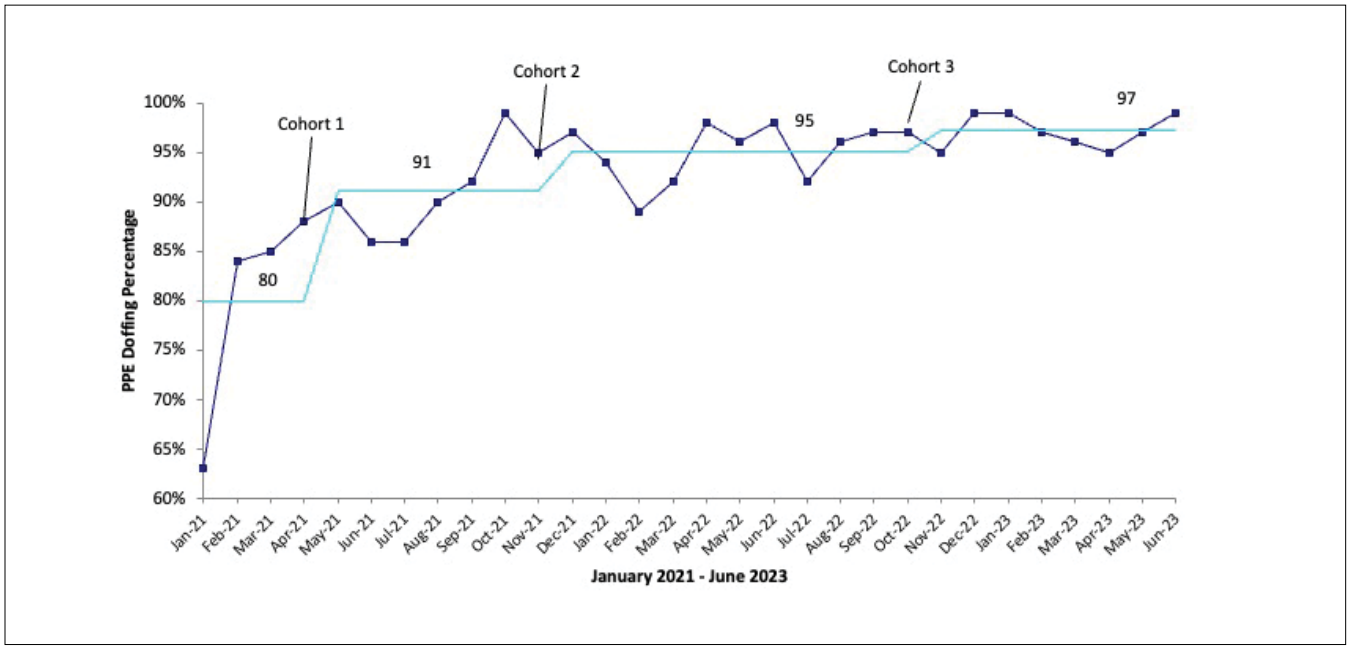

Figure 3: Personal Protective Equipment Doffing Run Chart across IPAC Safety Coaches Program

(p=0.46; n=4366; over 7 months) during the first cohort, further to 91% (p=0.5; n=15258; over 11 months) during the second cohort, and reached 94% (p=0.5; n=14394; over 8 months) in the third cohort, as depicted in Figure 1.

PPE donning compliance started at 73% (n=4258; over 4 months) at baseline and increased to 86% (p=0.007; n=1275; over 7 months) during the first cohort, further to 88% (p=0.003; n=5513; over 11 months) during the second cohort, and reached 92% (p=0.004; n=4011; over 8 months) in the third cohort, as depicted in Figure 2.

PPE doffing compliance started at 80% (n=8716; over 4 months) at baseline, and increased to 91% (p=0.01; n=1105; over 7 months) during the first cohort, further to 95% (p=0.002; n=3533; over 11 months) during the second cohort, and reach 97% (p=0.004; n=2396; over 8 months) in the third cohort, as depicted in Figure 3.

Secondary outcomes

The *C. difficile* rate at baseline was 0.20 per 1,000 patient days. Following the completion of three training cohorts, the *C. difficile* rate significantly decreased to 0.11 per 1,000 patient days (p=0.04), representing a 55% decrease from baseline, as depicted in Figure 4. Similarly, the CLABSI rate started at a baseline was 5.15 per 1,000 patient days. After the completion

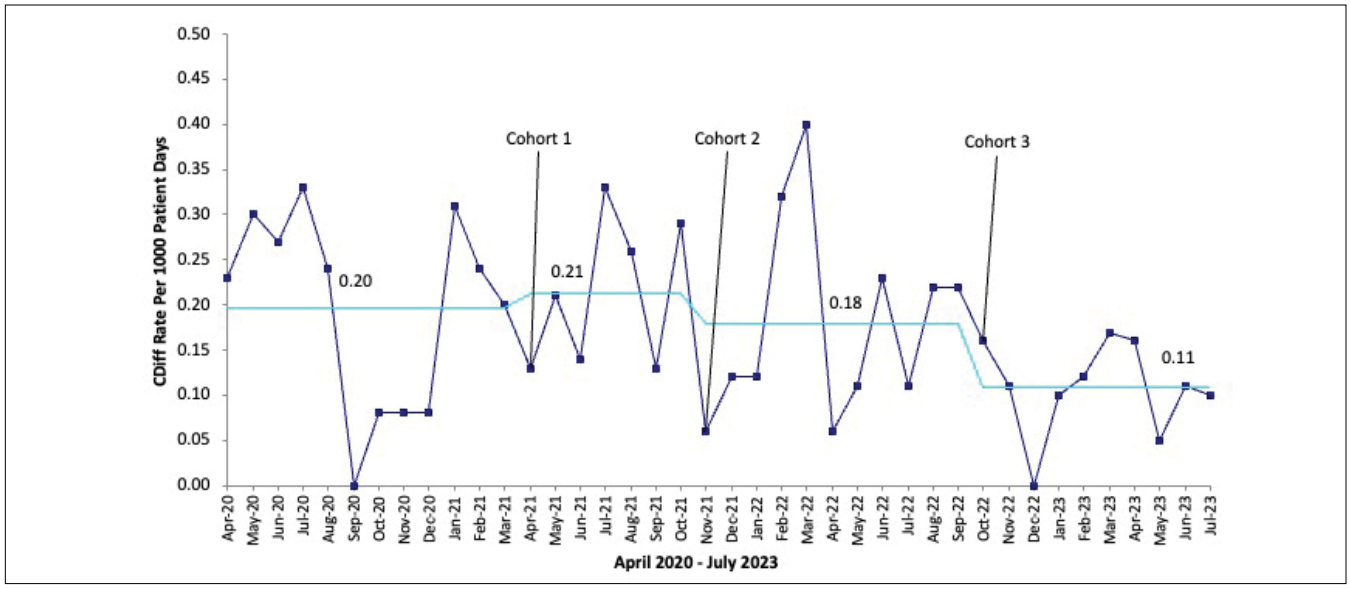

Figure 4: *Clostridioides difficile* Rate Run Chart across IPAC Safety Coaches Program

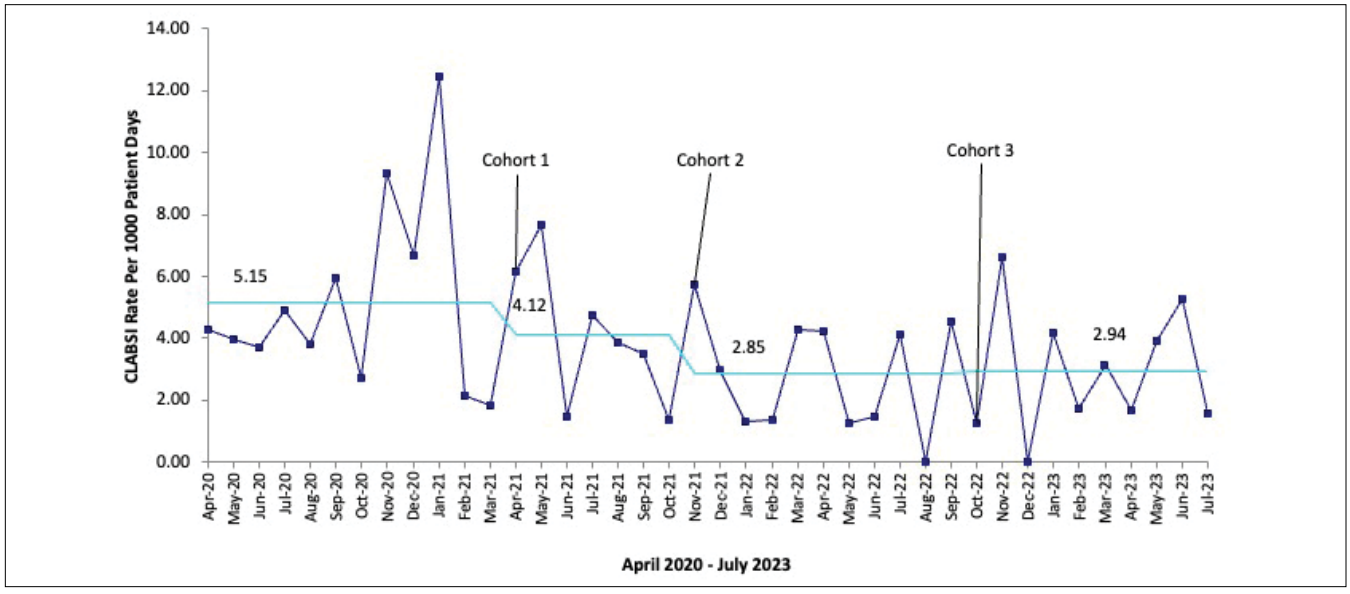

Figure 5: Central Line Bloodstream Infection Rate Run Chart across IPAC Safety Coaches Program

of three training cohorts, the CLABSI rate significantly decreased to 2.94 per 1,000 patient days (p=0.03) indicating a 57% decrease from baseline, as depicted in Figure 5.

DISCUSSION

This study details the design, implementation, and outcomes of the IPAC Safety Coaches Program across three cohorts of training sessions. Hand hygiene compliance increased by 6% with a trend towards significance. By the conclusion of the third cohort, statistically significant improvements were observed in PPE donning (16%) and PPE doffing (17%) compliance. Secondary outcomes also demonstrated statistically significant decreases in *C. difficile* (55%) and CLABSI (57%) rates.

Mackenzie Health embarked on a journey to become a high-reliability organization (HRO), striving to achieve zero harm across several hospital-acquired conditions (Clapper *et al.*, 2018; Pinto *et al.*, 2022; Redstone *et al.*, 2023; Wilson, Hacker Teper, *et al.*, 2022; Wilson, Sinno, *et al.*, 2022). The development of the IPAC Safety Coaches Program aligns with key HRO principles, aiming to empower safety coaches and enhance patient outcomes. These principles include minimizing hierarchy, viewing failures as learning opportunities rather than assigning blame, and fostering leadership support to cultivate a safe and just hospital culture (Lewin Group, 2008).

Reported data on hand hygiene compliance in the literature shows considerable variability. Hand hygiene compliance ranges from a national average of 50% in the United States, to nearly 80% in Ontario hospitals, with some reports exceeding 90% in certain U.S. healthcare settings (Wang *et*

al., 2022; Williams *et al.*, 2021; Makhni *et al.*, 2021). Our data fall within this variability. Literature on PPE donning and doffing compliance rates report figures slightly lower than our baseline, with contamination issues arising during audits (Kwon *et al.*, 2017; Kang *et al.*, 2016). Notably, these studies used fluorescence scanning and swabbing techniques, which may contribute to discrepancies between our findings and the literature. Despite observing higher rates of PPE donning and doffing compliance in our audits compared to other studies, the trends captured align with those in the literature: hand hygiene compliance generally exceeds doffing and donning compliance, and both improve with feedback.

The onset of COVID-19 significantly impacted healthcare systems, leading to staffing shortages, increased workloads, and dynamic workplace environments (Chervoni-Knapp, 2022; Murphy *et al.*, 2022). In Canada, these pressures resulted in widespread service closures, mass workforce turnover, and impacts on healthcare accessibility (Murphy *et al.*, 2022). The pandemic also had adverse effects on HAI rates. In the U.S., incidences of CLABSIs, CAUTIs, and MRSA surged during COVID-19 peaks, contrasting with previously declining HAIs rates (Baker *et al.*, n.d.).

Canadian hospitals observed a 4.5% increase in *C. difficile* rates per 1,000 patient admissions during the pandemic period from March 1, 2020 to June 30, 2021, compared to pre-pandemic rates (Choi *et al.*, 2022). The Canadian Nosocomial Infection Surveillance Program similarly noted a rise in *C. difficile* rates per 10,000 patient days from 4.90 in 2019 to 5.35 in 2020 (CNISP, 2023; Choi *et al.*, 2022. However, CNISP data indicated overall stability with a slight decline in reported C. difficile rates from 2019 to 2021.

Mackenzie Health experienced a similar increase in *C. difficile* infection rates post-pandemic. However, our data revealed a decrease in *C. difficile* infections starting in November 2021, with a more pronounced decline beyond the period covered by CNISP data after 2021.

Another challenge to the success of the program was balancing staff clinical duties with the time required for sessions and audits, particularly when these were not integrated into their routine responsibilities. Moreover, the period coincided with significant COVID-19-related attrition within our organization, and increased provider burnout. To mitigate these effects, broad stakeholder engagement was crucial, including senior leadership buy-in. The program was pragmatically designed to minimize disruption to clinicians during regular work hours. Financial support was provided for staff if attending sessions on days off, although this was rare, and administrative support included reducing clinical duties on audit days. Mandating only 30% in-person attendance allowed flexibility, and staff who attended 75% of sessions in-person were recognized and celebrated within their units. Across the three cohorts, 53-61% of candidates successfully completed the program, with the main challenge reported being difficulty balancing their clinical workloads. Feedback was collected electronically after each session, and also used to iteratively improve subsequent training sessions. Improvements included incorporating guest speakers, and adding more interactive components.

Limitations

The observational before-and-after study limits the strength of the associations we can infer with our interventions. Moreover, the study was limited to one institution with a modest number of observations during the COVID-19 pandemic, potentially limiting generalizability. Our secondary outcome measure, CLABSI rates, had a multidisciplinary team working on their reduction during a period overlapping with the IPAC Safety Coaches Program (Redstone *et al.*, 2023). This limits inferences on impact of the program on CLABSI reduction. Baseline data on hand hygiene and PPE compliance was also limited prior to 2021, restricting the baseline period to four months, limiting inferences on the baseline period. The growing audit team with each cohort introduces the possibility of inter-observer variability on observations. To minimize this variability, similar training and instructions were given to each cohort. Other potential sources of bias include participants performing audits on their own units and the Hawthorne effect. Standardized instructions were given to mitigate these biases, and audits were designed to be conducted unobtrusively. Furthermore, the direct and indirect program costs were not calculated, as the program was designed pragmatically for participation during regular clinical time. Finally, our study is limited to inferring long-term sustainability.

CONCLUSION

This study reports on the design, implementation, and outcomes of a novel IPAC Safety Coaches Program at Mackenzie Health, which was associated with improvements in PPE use, hand hygiene compliance, and reduction in *C. difficile* and CLABSI rates. The findings of the current study may strengthen safety practices and aid in combating HAIs and future pandemics. Future work should investigate other outcome variables and assess sustainability of these efforts.

REFERENCES

Amir Yeganeh, S., Lee, C. (2023). IPAC Safety Coaches – An Innovative Approach in Knowledge Transfer. IPAC Canada/PCI Canada. https://ipac-canada.org/photos/custom/conf/23conf/OralHandouts/144540_IPACSafetyCoaches_Slides.pdf

Baker, M. A., Sands, K. E., Huang, S. S., Kleinman, K., Septimus, E. J., Varma, N., Blanchard, J., Poland, R. E., Coady, M. H., Yokoe, D. S., Fraker, S., Froman, A., Moody, J., Goldin, L., Isaacs, A., Kleja, K., Korwek, K. M., Stelling, J., Clark, A., ... CDC Prevention Epicenters Program. (n.d.). The Impact of Coronavirus Disease 2019 (COVID-19) on Healthcare-Associated Infections. *Clinical Infectious Diseases, 74*(10), 1748–1754.

CDC. (2022). *Infection Control.* Centers for Disease Control and Prevention. https://www.cdc.gov/infectioncontrol/index.html

Chervoni-Knapp, T. (2022). The Staffing Shortage Pandemic. *Journal of Radiology Nursing, 41*(2), 74–75.

Choi, K. B., Du, T., Silva, A., Golding, G. R., Pelude, L., Mitchell, R., Rudnick, W., Hizon, R., Al-Rawahi, G. N., Chow, B., Davis, I., Evans, Frenette, C., Johnstone, J., Kibsey, P., Katz, K. C., Langley, J. M., Lee, B. E., Longtin, Y., & CNISP. (2022). Trends in *Clostridioides difficile* infection rates in Canadian hospitals during the coronavirus disease 2019 (COVID-19) pandemic. *Infection Control and Hospital Epidemiology, 44*(7), 1180–1183.

Clapper, C., Stockmeier, C., & Merlino, J. (2018). *Zero Harm: How to Achieve Patient and Workforce Safety in Healthcare*. McGraw-Hill Education.

Cristea, F., Weishaar, H., Geurts, B., Delamou, A., Mei, M., Tan, J., Legido-Quigley, H., Aminu, K., Mari-Sáez, A., Rocha, C., Camara, B., Barry, L., Thea, P., Boucsein, J., Bahr, T., Al-Awlaqui, S., Pozo-Martin, F., Boklage, E., Jegede, A. S., & El Bcheraoui, C. (2022). A comparative analysis of experienced uncertainties in relation to risk communication during COVID19: A four-country study. *Globalization and Health, 18*(66).

Dekker, M., Jongerden, I. P., de Bruijne, M. C., Jelsma, J. G. M., Vandenbroucke-Grauls, C. M., & van Mansfield, R. (2022). Strategies to improve the implementation of infection control link nurse programmes in acute-care hospitals. *Journal of Hospital Infection, 128*, 54–63.

Dekker, M., van Mansfeld, R., Vandenbroucke-Grauls, C. M., Lauret, T. E., Schutijser, B. C., de Bruijne, M. C., & Jongerden, I. P. (2022). Role perception of infection control link nurses; a multi-centre qualitative study. *Journal of Infection Prevention, 23*(3), 93–100.

Gambeta, K., & Chambers, A. (2021). Knowledge to action: Needs assessment to enhance support for infection control professionals across healthcare settings. *Canadian Journal of Infection Control, 36*(3), 86–93.

Gidey, K., Gidey, M. T., Hailu, B. Y., Gebreamlak, Z. B., & Niriayo, Y. L. (2023). Clinical and economic burden of healthcare-associated infections: A prospective cohort study. *PLoS One, 18*(2), e0282141.

Hilken, L., Dickson, A., & Sidley, C. (2017). Nurse Infection Prevention Champions: A Model for Success. *American Journal of Infection Control, 45*(6), s107.

IPAC. (n.d.). *IPAC CANADA/PCI CANADA*. https://ipac-canada.org/photos/custom/Members/pdf/21Jul20_IPACCanada_Focus.pdf

Kang, J., O'Donnell, J.M., Colainne, B., Bircher, N., Ren, D., and Smith, K.J. 2017. Use of personal protective equipment among health care personnel: Results of clinical observations and simulations. *American Journal of Infection Control, 45*(1), 17-23.

Kwon, J.H., Burnham, C.D., Reske, K, A., Liang, S.Y., Hink, T., Wallace, M.A., Shupe, A., Seiler, S., Cass, C., Fraser, V. J., and Dubberke, E.R. (2017). Assessment of Healthcare Worker Protocol Deviations and Self-Contamination During Personal Protective Equipment Donning and Doffing. *Infection Control and Hospital Epidemiology, 38*(9), 1077-1083.

Lowe, H., Woodd, S., Lange, I. L., Janjanin, S., Barnet, J., & Graham, W. (2021). Challenges and opportunities for infection prevention and control in hospitals in conflict-affected settings: A qualitative study. *Conflict and Health, 15*, 94.

Makhni, S., Umschied, C.A., Soo, J., Chu, V., Bartlett, A., Landon, E., and Marrs, R. (2021). Hand Hygiene Compliance Rate During the COVID-19 Pandemic. *JAMA Internal Medicine, 181*(7), 1006-1008.

Mody, M., & Gontjes, K. J. (2023). Health education after COVID-19: A time to revisit, revamp, and revitalize? *American Journal of Infection Control, 51*(4), 466–468.

Morgan, D. J., Lomotan, L. L., Agnes, K., McGrail, L., & Roghmann, M.-C. (2010). Characteristics of Healthcare-Associated Infections Contributing to Unexpected In-Hospital Deaths. *Infection Control and Hospital Epidemiology, 31*(8), 864–866.

Mossburg, S. E., Weaver, S. J., Pillari, M. S., & Biddison, E. D. (2019). Manifestations of High Reliability Principles on Hospital Units with Varying Safety Profiles: A Qualitative Analysis. *Journal of Nursing Care Quality, 34*(3), 230–235.

Murphy, G. T., Sampalli, T., Bearskin, L. B., Cashen, N., Cummings, G., Rose, A. E., Etowa, J., Grinspun, D., Jones, E. W., Lavoie-Tremplay, M., MacMillan, K., MacQuarrie, C., Martin-Misener, R., Oulton, J., Ricciardelli, R., Silas, L., Thorne, S., & Villeneuve, M. (2022). Investing in Canada's nursing workforce post-pandemic: A call to action. *Facets, 7*, 1051–1120.

NHS. (2023). *Become an Infection Prevention and Control Lead/Link Person*. Suffolk and North East Essex ICB. https://suffolkandnortheastessex.icb.nhs.uk/health-and-care-professionals-area/infection-prevention/become-an-infection-prevention-and-control-lead-link-person/

PHAC. (2013). *The Chief Public Health Officer's Report on the State of Public Health in Canada 2013 – Healthcare-associated infections – Due diligence*. Government of Canada.

PHO. (n.d.). *PPE Recommended Steps*. Public Health Ontario.

PHO. (2020). *Just Clean Your Hands – Hospitals*. Public Health Ontario. https://www.publichealthontario.ca/en/Health-Topics/Infection-Prevention-Control/Hand-Hygiene/JCYH-Hospitals

PHO. (2022). *IPAC Recommendations for Use of Personal Protective Equipment for Care of Individuals with Suspect or Confirmed COVID-19, 2nd Edition*. Public Health Ontario. https://www.publichealthontario.ca/-/media/documents/ncov/updated-ipac-measures-covid-19.pdf?la=en

PICNet. (n.d.). *Healthcare-Associated Infections.* Provincial Infection Control Network of British Columbia. https://picnet.ca/surveillance/healthcare-associated-infections/#:~:text=HAIs%20are%20a%20major%20patient,in%20at%20least%208%2C000%20deaths

Pinto, D. N., Tsourgiannis, J., Wintraub, L., Richards, P., Wilson, M.-A., Soheili, A., Sinno, M., & Taher, A. (2022). A quality improvement initiative to decrease in-hospital irretrievable specimen loss: A "zero harm" approach. *Canadian Journal of Pathology, 14*(3), 17–35.

Provincial Infectious Diseases Advisory Committee. (2012). *Best Practices for Infection Prevention and Control Programs in All Health Care Settings, 3rd edition*. Queen's Printer for Ontario. https://www.publichealthontario.ca/-/media/documents/B/2012/bp-ipac-hc-settings.pdf

Public Health Ontario. (2013). *Annex C: Testing, Surveillance and Management of Clostridium difficile*. Provincial Infectious Diseases Advisory Committee on Infection Prevention and Control. https://www.publichealthontario.ca/-/media/documents/C/2013/cdiff-testing-surveillance-management.pdf

Public Health Ontario. (n.d.) *Your 4 Moments for Hand Hygiene*. https://www.publichealthontario.ca/-/media/documents/9/2008/4-moments-poster-series.pdf?la=en

Redstone, C. S., Zadeh, M., Wilson, M.-A., McLachlan, S., Chen, D., Sinno, M., Khamis, S., Malis, K., Lui, F., Forani, S., Scerbo, C., Hutton, Y., Jacob, L., & Taher, A. (2023). A Quality Improvement Initiative to Decrease Central Line-Associated Bloodstream Infections During the COVID-19 Pandemic: A "Zero Harm" Approach. *Journal of Patient Safety, 19*(3), 173–179.

Safer Healthcare Now. (2012). *Prevent Central Line Infections Getting Started Kit*. https://www.patientsafetyinstitute.ca/en/toolsResources/Documents/Interventions/Central%20Line-Associated%20Bloodstream%20Infection/CLI%20Getting%20Started%20Kit.pdf

Stewart, S., Robertson, C., Pan, J., Kennedy, S., Haahr, L., Manoukian, S., Mason, H., Kavanagh, K., Graves, N., Dancer, S. J., Cook, B., & Reilly, J. (2021). Impact of healthcare-associated infection on length of stay. *Journal of Hospital Infection, 114*, 23–31.

Veazie, S., Peterson, K., & Bourne, D. (2019). *Evidence Brief: Implementation of High Reliability Organization Principles*. Department of Veterans Affairs (US). https://www.ncbi.nlm.nih.gov/books/NBK542883/#:~:text=High%20Reliability%20Organizations%20(HROs)%20are,that%20work%20is%20complex%2C%20with

Vogus, T. J., & Hilligoss, B. (2015). The underappreciated role of habit in highly reliable healthcare. *BMJ Quality and Safety, 25*(3), 1–6.

Wang, Y., Yang, J., Qiao, F., Feng, B. Hu, F. Xi, Z., Wu, W., Ni, Z., Liu, L., and Yuan, Y. (2022). Compared hand hygiene compliance among healthcare prociders before and after the COVID-19 pandemic: A rapid review and meta-analysis. *American Journal of Infection Control, 50*(5), 563-571.

WHO. (n.d.). *Global Infection Prevention and Control Network*. World Health Organization. https://www.who.int/groups/global-infection-prevention-and-control-network/about-us

WHO. (2010). *The burden of health care-associated infection worldwide*. World Health Organization. https://www.who.int/news-room/feature-stories/detail/the-burden-of-health-care-associated-infection-worldwide

Williams, V., Kovacs-Litman, A., Muller, M.P., Hota, S., Powis, J.E., Ricciuto, D.R., Mertz, D., Katz, K., Castellani, L., Kiss, A., Linkenheld-Struk, A., and Leis, J.A. (2021). Impact of COVID-19 on hospital hand hygiene performance: a multicenter observational study using group electronic monitoring. *CMAJ Open, 9*(4), E1175-E1180.

Wilson, M.-A., Hacker Teper, M., Sinno, M., Kohlberger, K., Nuseir, D., Chan, A., Palomera-Dinglasan, K., Leon, L., Donaldson, D., & Taher, A. (2022). Designing and Implementing a Zero Harm Falls Prevention Program: A Quality Improvement Study. *Journal of Nursing Care Quality, 37*(3), 199–205.

Wilson, M.-A., Sinno, M., Hacker Teper, M., Courtney, K., Nuseir, D., Schonewille, A., Rauchwerger, D., & Taher, A. (2022). Toward Zero Harm: Mackenzie Health's Journey Toward Becoming a High Reliability Organization and Eliminating Avoidable Harm. *Journal of Patient Safety, 18*(7), 680–685.