



COVID-19 infection prevention and control procedures and institutional trust: Perceptions of Canadian intensive care and emergency department nurses

Procédures de prévention et de contrôle des infections à la COVID-19 et confiance institutionnelle : perceptions du personnel infirmier des services de soins intensifs et d'urgence au Canada

Sarah L. Silverberg, MD · Lisa M. Puchalski Ritchie, MD, PhD, FRCPC ·
Nina Gobat, PhD · Srinivas Murthy, MD, FRCPC

Received: 3 November 2020 / Revised: 29 March 2021 / Accepted: 13 April 2021 / Published online: 27 May 2021
© The Author(s) 2021

Abstract

Purpose Healthcare workers must ensure effective infection prevention and control (IPC) to prevent nosocomial spread of SARS-CoV-2, the virus that causes COVID-19. This questionnaire study aims to evaluate Canadian critical care and emergency department nurses' readiness to follow IPC guidelines in their workplace, and to understand their perceptions of trust in organizational preparedness, communication, and infection risk.

Methods We adapted an internationally distributed survey for the Canadian context. This cross-sectional questionnaire, incorporating validated scales for items including institutional trust, was distributed by email to

nurses via the Canadian Association of Critical Care Nurses and the Canadian Association of Emergency Physicians networks between 16 March and 25 May 2020. We evaluated intensive care unit and emergency department nurses' adherence to IPC protocols, barriers and facilitators to IPC guideline adherence, and their level of institutional trust.

Results Three hundred and nineteen nurses responded to the survey. There was higher trust in organizational preparedness among nurses who were older ($B = 0.31$, $P < 0.001$) and more experienced ($F = 18.09$, $P < 0.001$), and particularly among those with previous experience working in outbreak settings ($F = 7.87$, $P = 0.005$). Compared with those without experience working in outbreak settings, respondents with this experience reported higher levels of fear of becoming ill and fear of providing care for COVID-19 patients ($\chi^2 = 21.48$, $P =$

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s12630-021-02028-9>) contains supplementary material, which is available to authorized users.

S. L. Silverberg, MD (✉)
Department of Pediatrics, University of British Columbia,
Vancouver, BC, Canada
e-mail: sarah.silverberg@alumni.ubc.ca

Department of Pediatrics, BC Children's Hospital, 4500 Oak
Street, Vancouver, BC V6H 3N1, Canada

L. M. P. Ritchie, MD, PhD, FRCPC
Department of Medicine, University of Toronto, Toronto, ON,
Canada

Li Ka Shing Knowledge Institute, St. Michael's Hospital,
Toronto, ON, Canada

Department of Emergency Medicine, University Health
Network, Toronto, ON, Canada

Institute of Health Policy, Management and Evaluation,
University of Toronto, Toronto, ON, Canada

NinaGobat, PhD
Nuffield Department of Primary Care Health Sciences,
University of Oxford, Oxford, UK

S. Murthy, MD, FRCPC
Department of Pediatrics, University of British Columbia,
Vancouver, BC, Canada

0.002 and $\chi^2 = 12.61$, $P = 0.05$, respectively). Older and more experienced nurses reported greater comfort with IPC skills and easier access to personal protective equipment. While the vast majority (96%) of respondents reported using masks and gloves, only 83% had access to isolation facilities for suspected or confirmed COVID-19 cases.

Conclusion Canadian nurses had strong self-reported adherence to IPC measures and personal protective equipment use. There were high levels of trust in health system leadership to ensure protective measures are present and reliable. Trust was particularly high among older and more experienced nurses despite these populations reporting higher levels of fear of personal illness.

Résumé

Objectif Les travailleurs de la santé doivent assurer l'efficacité de la prévention et du contrôle des infections (PCI) pour prévenir la propagation nosocomiale du SRAS-CoV-2, le virus qui cause la COVID-19. Cette étude sous forme de questionnaire vise à évaluer le degré de préparation des infirmières et infirmiers des services d'urgence et de soins intensifs canadiens à suivre les lignes directrices de la PCI sur leur lieu de travail, ainsi qu'à comprendre leur degré de confiance dans la préparation, la communication et le risque d'infection au niveau de l'organisation.

Méthode Nous avons adapté un sondage distribué à l'échelle internationale au contexte canadien. Ce questionnaire sectoriel, incorporant des échelles validées pour des éléments tels que la confiance institutionnelle, a été distribué par courriel aux infirmières et infirmiers par l'entremise de l'Association canadienne des infirmiers/infirmières en soins intensifs et des réseaux de l'Association canadienne des médecins d'urgence entre le 16 mars et le 25 mai 2020. Nous avons évalué l'adhésion du personnel infirmier des unités de soins intensifs et des services d'urgence aux protocoles de la PCI, les obstacles et les facilitateurs à l'observance des lignes directrices de la PCI, ainsi que leur niveau de confiance institutionnelle.

Résultats Trois cent dix-neuf infirmières et infirmiers ont répondu au questionnaire. Il y avait une plus grande confiance dans la préparation organisationnelle chez les infirmières et infirmiers plus âgés ($B = 0,31$, $P < 0,001$) et plus expérimentés ($F = 18,09$, $P < 0,001$), et en particulier parmi celles et ceux qui avaient déjà travaillé dans des contextes d'éclosion ($F = 7,87$, $P = 0,005$). Comparativement à celles et ceux qui n'ont pas d'expérience dans des contextes d'éclosion, les répondant(e)s avec expérience ont signalé des niveaux plus élevés de peur de tomber malade et de peur de fournir des soins aux patients atteints de la COVID-19 ($\chi^2 = 21,48$,

$P = 0,002$ et $\chi^2 = 12,61$, $P = 0,05$, respectivement). Les infirmières et infirmiers plus âgés et plus expérimentés ont déclaré être plus à l'aise avec leurs compétences en PCI et avoir un meilleur accès aux équipements de protection individuelle. Alors que la grande majorité (96 %) des répondant(e)s ont déclaré avoir utilisé des masques et des gants, seulement 83 % avaient accès à des zones d'isolement pour les cas présumés ou confirmés de COVID-19.

Conclusion Les infirmières et infirmiers canadiens ont rapporté une forte adhésion aux mesures de la PCI et à l'utilisation des équipements de protection individuelle. Il y avait un niveau élevé de confiance dans le leadership du système de santé pour s'assurer que les mesures de protection étaient présentes et fiables. La confiance était particulièrement élevée chez le personnel infirmier plus âgé et plus expérimenté, bien les niveaux de peur d'être personnellement atteint de la maladie étaient plus élevés pour ces infirmières et infirmiers.

Keywords COVID-19 · infection prevention and control · pandemic preparedness · nurses

Healthcare workers (HCWs) play a critical role in providing quality healthcare for patients infected with SARS-CoV-2, the virus that causes COVID-19. Critical care and emergency department nurses, as well as other healthcare workers, must ensure effective infection prevention and control procedures (IPC) are appropriately used to prevent nosocomial spread and disease acquisition.¹ Simultaneously, there are competing pressures and additional challenges in providing care, including higher patient volumes and acuity, a higher personal risk, limited and more judicious resource use, and increased rates of burnout.²⁻⁵ There is increased anxiety and fear among front-line HCWs such as nurses for their own safety and that of their families.⁶ Organizational and social factors, including HCW confidence in their ability to effectively deliver IPC, are important to protect physical and psychological health.⁷ Further, workplace culture, as well as an increased support by local institutions and management, are key factors in adherence to IPC guidelines.⁸⁻¹⁰

During the COVID-19 pandemic, use of personal protective equipment (PPE) and trust in institutions' differing PPE recommendations and requirements has become a significant issue. While PPE recommendations in hospital settings have been largely consistent, use and availability of equipment has been variable.¹¹ During previous outbreaks, willingness to work decreased when there was a lack of PPE and when there was a perception of

putting oneself or one's family at risk.^{6,12} Further, trust in government has historically been considered an important determinant of citizens' adherence to public health policies and guidelines. Belief in recommendations from government and public health officials leading to the adoption of necessary behaviours to decrease risk, as well as a decrease in anxieties, stems from effective communication from officials along with actions that follow-through, and satisfaction with their performance.^{13,14} A better understanding of factors associated with institutional trust among HCWs is needed to inform policy and practices to support staff health and wellbeing. In this study, our primary objective was to evaluate ICU and emergency department nurses' barriers and facilitators of IPC guideline adherence, along with their level of trust in organizational and government readiness. We sought to characterize their perceptions of IPC guidelines they have received, adherence to IPC protocols, readiness to adhere to IPC guidelines to prevent SARS-CoV-2 infection in their place of work, and their perceived level of personal risk.

Methods

We conducted a cross-sectional online survey to rapidly assess the views and readiness of Canadian HCWs who were providing care in community and hospital settings (Electronic Supplementary Material [ESM]). We sought to follow previously published survey reporting guidelines.^{15,16} We used a survey that was developed by the World Health Organization COVID-19 Research Roadmap Social Science and IPC working groups at the onset of the COVID-19 pandemic, because no previously validated measure of HCW perceptions was suitable.^{17–19} Internationally, the survey comprised basic respondent demographic and pandemic work experience characteristics as well as a series of closed-ended questions eliciting beliefs and practices of HCWs in the context of the COVID-19 outbreak. Once these questions were developed, the Theoretical Domains Framework (TDF) was used to evaluate the completeness of included items.^{20,21} The TDF, which had previously been applied to understanding clinicians' behaviour, provides a framework that captures core constructs from multiple behavioural theories into 14 domains.²² Questions for this survey addressed the following TDF domains: knowledge; skills; social/professional role and identity; beliefs about capabilities; beliefs about consequences; environmental context and resources; and intentions, social influences and emotions. Additional items in the survey, not included in the TDF framework, assessed three dimensions of institutional trust (competence, honesty, acting in best

interests of HCWs) and were based on a previously validated measure.²³ Items were created on a seven-point Likert scale, ranging from "strongly disagree" to "strongly agree". A total of 41 Likert scale questions were asked as well as 13 targeted questions regarding basic demographics and work context. Our survey was adapted to fit the Canadian context; additions and changes to the international version included non-binary gender options and rewording of clinical roles, practice setting, and employment type for consistency with Canadian terminology.

We employed convenience sampling through email and Slack channels via the distribution lists of the Canadian Association of Critical Care Nurses (CACCN) (1,100 list serve members) and the Canadian Association of Emergency Physicians (CAEP) (1,857 listserve members). Both organizations approved access to their listserves for this purpose. These organizations were chosen as they were felt to be representative of HCWs in a variety of Canadian critical care and emergency settings; they are large, broad networks with membership across Canada and representation from both academic and community hospitals. The survey was distributed between 16 March 2020 and 25 May 2020, over the course of the initial surge of COVID-19 in Canada (ESM, eFigure).²⁴ The survey was sent out weekly for three consecutive weeks. The survey remained open for an additional two weeks following the final reminder. Study data were collected and managed using REDCap electronic data capture tools hosted at BC Children's Hospital.²⁵ All questionnaires were self-administered digitally, with voluntary participation, and consent was implied by survey completion. We did not collect re-identifiable information, including any linked personal identifiable information. The protocol was approved by The University of British Columbia/Children's and Women's Health Centre of British Columbia Research Ethics Board (Vancouver, BC, Canada) (Reference number: H20-00803). Research Ethics Board approval was not required or sought from investigators' other affiliations.

Although distributed across multi-disciplinary networks, the majority of respondents were nurses. As a result of the poor response rate from HCWs in non-nursing categories limiting our ability to make valid comparisons across groups, we limited our analysis to nurses.

Statistical analysis

Our analysis was primarily descriptive. Incomplete surveys were included for the questions to which they contributed. We present descriptive statistics as proportions and mean (standard deviation [SD]) for continuous variables or median [interquartile range (IQR)] for discrete scales.

Seven-point Likert scales were used to assess agreement with statements of belief, with a seven indicating “strongly agree” and one indicating “strongly disagree”. Our survey aimed to align analytical approaches with other adaptations of this survey being conducted in other international settings.

A series of composite scores was created as a summation of the Likert responses in the category. To assess trust in health facilities and government, the survey tool contained a validated trust measure, comprising three statements graded on a seven-point Likert scale that capture three different dimensions of trust: perceptions of competence, honesty, and actions that are in the employees’ best interests. These levels of trust were each asked of three levels of governance: local health facility, regional government, and national government (ESM).²³ These nine questions were combined into a single “Trust score” out of a maximum of 63 points. Furthermore, we combined the scored Likert responses under the following thematic groups to further interpret the data: emotions, service demand, environment, skills and intentions, beliefs, and social influences/professional role. The Emotions score was based on responses to questions regarding perceived personal risk and fear on the job. The Service Demand score reflected perceptions of whether the health system can handle current and future patient demands. The Environment score reflected the clarity of reporting measures of exposures, guidance materials, and ease of access to infection control practices. The Skills and Intentions combined score reflected training, confidence, and use of PPE. The Professional and Social Role score reflected how perceptions of IPC measures are reflected in one’s role and the influence on others’ IPC adherence. Finally, the Beliefs score was calculated from answers regarding their beliefs in the effectiveness of PPE and IPC procedures, and the amount of strain these procedures create. For the belief category, where two questions were framed in the positive and two in the negative, negative scores were reversed and added to positive ones to develop a composite score.

We stratified number of children into any vs no children, and stratified years since completion of training into < 5 years, 5–10 years, 11–20 years, and > 20 years. We additionally stratified marital status into no partner, partnered, and prefer not to say, and practice setting into community hospital, academic hospital, and other. We created an aggregate COVID Care score based on whether respondents reported any suspected or confirmed COVID-19 cases in their hospital (yes or no/unsure), and whether they cared for a suspected or confirmed COVID-19 patient (yes or no/unsure), with “yes” responses corresponding to one point and “no” or “unsure” responses contributing to no points, with the total score ranging from 0 to 2. Similarly, we created an aggregate epidemic score, based

on whether they’ve worked in a clinical setting (yes or no/unsure) in a previous epidemic and cared for a patient in that setting (yes or no/unsure), with “yes” responses corresponding to one point and “no” or “unsure” responses contributing to no points, with the total score ranging from 0 to 2.

We compared responses to individual questions using Kruskal–Wallis or Chi square tests for categorical variables and compared continuous variables using univariate linear regressions and Student’s *t* tests. We assessed responses to composite score measures using one-way analysis of variance (ANOVA) and assessed categorical and continuous variables using linear regressions and student *t* tests, respectively. We reported the T-statistic from Student’s *t* tests as T, the beta from linear regressions as B, and the F-statistic from one-way ANOVAs as F. To control for potential type 1 errors from multiple tests, a new threshold of significance was calculated using the Bonferroni correction for each model. The adapted level of significance for these correlations was $P = 0.0055$ (0.05/9).

Results

Respondent characteristics

We analyzed responses from 319 nurses. The general survey completion rate for all respondents was 78%. The total response rate was incalculable because of the nature of the distribution network across more than one listserv.

The majority of respondents were bedside ICU and emergency nurses ($n = 256$), with the remainder working in a variety of nursing roles including nurse specialists, nurse educators, and charge nurses. The majority were female (83%) and partnered (71%), with a mean (SD) age of 41.7 (11.5) yr (Table 1). Almost two-thirds of respondents worked in academic hospitals (63%), while 35% worked in community settings and the remainder worked in other settings. On average, respondents had been in practice for 15 (11) yr. Over half of respondents had previously worked in a clinical setting during an epidemic (60%), while 63% had personal experience caring for patients with a novel respiratory pathogen (e.g., SARS, MERS Co-V, H1N1) (Table 2). Over 90% respondents were working in settings that had provided care for patients with suspected and/or confirmed COVID-19, while two-thirds (66%) had personally cared for COVID-19 patients.

Access to and perception of personal protective equipment

Respondents reported a high rate of PPE use for suspected or confirmed cases of COVID-19, with universal use of

TABLE 1 Respondent characteristics

Characteristic	
Age (yr), mean (SD)	41.7 (11.5) <i>n</i> = 193
Gender, <i>n</i>/total <i>N</i> (%)	
Female	139/168 (83%)
Male	27/168 (16%)
Prefer not to say	2/168 (1%)
Children < 17 yr of age, <i>n</i>/total <i>N</i> (%)	
One or more	97/318 (31%)
None	212/318 (67%)
Prefer not to say	9/318 (3%)
Role in healthcare, <i>n</i>/total <i>N</i> (%)	
Bedside nurse	256/319 (80%)
Charge nurse	24/319 (8%)
Nurse practitioner	12/319 (4%)
Other nurse (e.g., nurse educator)	27/319 (9%)
Length of time in independent practice (yr), mean (SD)	15.0 (10.7) <i>n</i> = 213
Clinical service setting, <i>n</i>/total <i>N</i> (%)	
Community hospital	11/319 (35%)
Academic hospital	200/319 (63%)
Outpatient setting or Other	9/319 (3%)
Provide direct patient care, <i>n</i>/total <i>N</i> (%)	
Yes	302/319 (95%)
No or Unsure	16/319 (5%)
Job type, <i>n</i>/total <i>N</i> (%)	
Full-time	240/319 (75%)
Part-time	60/319 (19%)
Casual or locum staff	19/319 (6%)

SD = standard deviation.

hand hygiene (100%), and very high rates of use of face masks (97%) and disposable gloves (99%) (*n* = 229) (Table 2). Respondents also reported high use of gowns and face shields (86% each), while isolation was only used in 84% of cases. Overall, respondents reported moderate ease in accessing PPE, with a median [IQR] score of 5 [3–6] out of 7. Bedside nurses reported higher scores on the combined Environment measure (*T* = 2.36; 95% confidence interval [CI], 0.53 to 6.08; *P* = 0.02) compared with all other nurses, indicating they had easier access to PPE and isolation facilities and had clear IPC policies that were well supported by public health authorities; however, this difference was not significant after adjustment for multiple comparisons (Figure;

Table 3). Older respondents and those with more years of experience also reported higher scores compared with younger respondents and those earlier in their independent career (*B* = 0.15, *P* = 0.02 and *F* = 15.77, *P* < 0.001, respectively), with only years in independent practice being significant after adjustment for multiple comparisons (Table 3). Over 95% of respondents indicated positively (agree or strongly agree) that they intend to always use a mask, eye protection, gown and gloves when taking care of suspected or confirmed COVID-19 patients. There was no observed difference among respondents based in academic hospitals compared with other settings.

Perceived risk of COVID-19 infection

Respondents were most concerned about the risk to their families and their own risk of becoming ill (Figure). The majority of respondents (59%) disagreed with the statement that they have little control over whether or not they become infected with COVID-19, with only 27% affirming the statement. Older respondents disagreed more strongly with questions related to fears, with a lower Emotions score showing overall less fear for themselves and their families (*B* = -0.16, *P* < 0.001) (Table 3). Those with previous experience working during outbreaks scored highest on fear of becoming ill and fear of looking after patients with COVID-19 ($\chi^2 = 21.48$, *P* = 0.002 and $\chi^2 = 12.61$, *P* = 0.05, respectively). Partnered status did not significantly influence respondents' Emotions score, nor did whether they had children (*F* = 3.03, *P* = 0.08 and *T* = -1.60, *P* = 0.11, respectively) (Table 3).

Professional and social role

Respondents reported very high rates of agreement with statements regarding expectations to follow IPC guidelines (99% agreement), the importance of following IPC guidelines to prevent COVID-19 spread (98% agreement), and that they encourage junior colleagues to adhere to IPC guidelines (98% agreement) (Figure). Those with more years of experience since completing training scored higher on the combined measure (*F* = 5.50, *P* = 0.02) indicating they felt more strongly that there is an expectation to follow IPC guidelines as part of their role, and that there is a culture of support from senior staff to junior staff to adhere to IPC protocols; however, this was not significant after adjustment for multiple comparisons (Table 3).

Beliefs

Respondents felt strongly that, while IPC procedures add to their workload, they are a necessary additional strain; with

TABLE 2 Respondent experiences related to COVID-19 epidemic and previous outbreaks

Experience	n/total N (%)
Personal experience previously working in a clinical setting during an acute respiratory epidemic or pandemic	
Yes	190/319 (60%)
No	126/319 (40%)
Unsure	3/319 (1%)
Experience personally caring for patients with suspected or confirmed infection caused by a novel respiratory pathogen in a clinical setting	
Yes	201/318 (63%)
No	106/318 (33%)
Unsure	11/318 (4%)
In your current job role as healthcare worker, how frequently (if at all) do you have direct patient contact?	
Daily	229/319 (72%)
More than one day per week	68/319 (21%)
Less than one day per week	10/319 (3%)
Rarely	8/319 (3%)
No patient contact	4/319 (1%)
Has a patient with suspected or confirmed COVID-19 attended the hospital in which you work?	
Yes	302/319 (95%)
No	10/319 (3%)
Unsure	7/319 (2%)
Have you personally cared for a patient with suspected or confirmed COVID-19 infection?	
Yes	229/319 (72%)
No	80/319 (25%)
Unsure	10/319 (3%)
What personal protective equipment did you use when you cared for a suspected/confirmed COVID-19 patient?*	
Hand hygiene	229/229 (100%)
Disposable gloves	226/229 (99%)
Face masks	221/229 (97%)
Disposable gowns	197/229 (86%)

TABLE 2 continued

Experience	n/total N (%)
Face shields	196/229 (86%)
Isolating patients with confirmed infection	192/229 (84%)
Eye protection	148/229 (65%)
Avoiding patient contact	53/229 (23%)
Full body suits	0/229 (0%)

* Percentages reflect the percent of respondents who answered "Yes" to the previous question (whether they have personally cared for a patient with suspected or confirmed COVID-19 infection).

only 14% reporting that IPC procedures are an unnecessary strain (Figure). Respondents were more ambivalent as to whether IPC measures would effectively prevent COVID-19 spread. Bedside nurses had higher overall Beliefs score ($T = 2.93$; 95% CI, 0.44 to 2.30; $P = 0.004$) (Table 3) than all other nurses, showing confidence in PPE and IPC procedures. Experience working in previous epidemics or in centres with COVID-19 did not influence respondents' Beliefs score.

Skills and Intentions

Overall, respondents reported a very high affirmation of always using PPE when caring for COVID-19 patients (Figure). While only 7% of respondents felt they had insufficient training in IPC for general communicable diseases, 19% felt they had insufficient IPC training specifically for COVID-19. Older respondents and those further from training felt more strongly that they had sufficient skills ($B = 0.05$, $P = 0.05$ and $F = 8.58$, $P = 0.004$, respectively), with only years in independent practice being significantly associated with higher confidence in their IPC skills after adjustment for multiple comparisons. Those with experience working in previous pandemics or with novel respiratory pathogens felt more confident regarding their skills compared with those without previous exposure ($F = 5.33$, $P = 0.02$), which was not significant after adjustment for multiple comparisons. Bedside nurses, compared with all other nurses, felt more confident in their IPC skills ($T = 2.60$; 95% CI, 0.31 to 2.33; $P = 0.01$), which was not significant after adjustment for multiple comparisons.

TABLE 3 Associations between respondent characteristics and aggregated perspective scores*†

	Bedside nurses§	Time since training‡	Age 	Gender§	Marital status‡	Children§	Practice setting‡	COVID Care score‡,**	Epidemic score‡***
Emotions score	T = - 0.98, P = 0.33; 95% CI, - 3.27 to 1.11	F = 4.99, P = 0.03	B = 0.16, P < 0.001	T = - 1.81, P = 0.08; 95% CI, - 6.16 to 0.35	F = 3.03, P = 0.08	T = - 1.60, P = 0.11; 95% CI, - 3.22 to 0.34	F = 0.18, P = 0.67	F = 1.35, P = 0.25	F = 7.86, P = 0.005
Service Demand score	T = 0.88, P = 0.38; 95% CI, - 0.68 to 1.76	F = 3.15, P = 0.08	B = 0.02, P = 0.34	T = - 0.35, P = 0.73; 95% CI, - 2.08 to 1.46	F = 0.04, P = 0.84	T = - 0.43, P = 0.66; 95% CI, - 1.18 to 0.76	F = 1.14, P = 0.29	F = 1.02, P = 0.31	F = 2.60, P = 0.11
Skills and Intentions score	T = 2.60, P = 0.01; 95% CI, 0.31 to 2.33	F = 8.58, P = 0.004	B = 0.05, P = 0.05	T = 0.22, P = 0.83; 95% CI, - 1.39 to 1.72	F = 1.72, P = 0.19	T = - 0.72, P = 0.47; 95% CI, - 1.19 to 0.56	F = 1.37, P = 0.24	F = 1.27, P = 0.26	F = 5.33, P = 0.02
Beliefs score	T = 2.93, P = 0.004; 95% CI, 0.44 to 2.30	F = 3.63, P = 0.06	B = 0.01, P = 0.56	T = 0.75, P = 0.46; 95% CI, 2.29 to 1.70	F = 0.04, P = 0.84	T = - 1.17, P = 0.24; 95% CI, - 1.48 to 0.38	F = 0.02, P = 0.88	F = 0.11, P = 0.74	F = 0.08, P = 0.78
Environment score	T = 2.36, P = 0.02; 95% CI, 0.53 to 6.08	F = 15.77, P < 0.001	B = 0.15, P = 0.02	T = 1.11, P = 0.28; 95% CI, - 2.27 to 7.64	F = 0.27, P = 0.61	T = - 1.46, P = 0.15; 95% CI, - 4.07 to 0.60	F = 0.22, P = 0.64	F = 0.06, P = 0.80	F = 6.79, P = 0.01
Professional and social roles	T = 1.38, P = 0.17; 95% CI, - 0.31 to 1.75	F = 5.50, P = 0.02	B = 0.02, P = 0.57	T = 0.72, P = 0.48; 95% CI, - 1.21 to 2.55	F = 0.64, P = 0.43	T = 1.17, P = 0.24; 95% CI, - 0.45 to 1.63	F = 0.15, P = 0.70	F = 1.71, P = 0.19	F = 0.01, P = 0.93
Trust score	T = 3.74, P < 0.001; 95% CI, 3.26 to 10.64	F = 18.09, P < 0.001	B = 0.31, P < 0.001	T = - 0.02, P = 0.85; 95% CI, - 6.26 to 5.16	F = 0.46, P = 0.50	T = - 0.11, P = 0.92; 95% CI, - 3.15 to 2.82	F = 0.37, P = 0.54	F = 0.89, P = 0.35	F = 7.87, P = 0.005

*Scores represent combined responses to multiple seven-part Likert-scale questions to form a combined aggregate thematic score. The emotions score reflects perceived personal risk and fear on the job. Service Demand score reflects perceptions of whether the health system can handle current and future patient demands. Environment score reflects the clarity of guidance materials and ease of access to facilities and PPE. Skills and Intentions combined measure reflects training, confidence, and use of PPE. The beliefs score reflects beliefs in the effectiveness of IPC and the amount of strain procedures create. The professional and social role scores reflects perception of how IPC measures are reflected in one’s role, and the potential influence on others.

† The adjusted threshold of significance (using the Bonferroni correction) was $P = 0.0055$. The significant findings are highlighted in bold.

‡ Associations evaluated by one-way ANOVA

§ Associations evaluated by Student’s *t* test

||Associations evaluated by linear regression

**Aggregate COVID Care score, based on whether respondents reported any suspected or confirmed COVID-19 cases in their hospital, and whether they cared for a suspected or confirmed COVID-19 patient. Aggregate epidemic score, based on whether they’ve worked in a clinical setting in a previous epidemic and cared for a patient in that setting. For each score, an affirmative answer on each of the two questions was awarded one point, with each score comprising two questions worth up to one point each for a maximum of two points per score.

ANOVA = analysis of variance; CI = confidence interval; IPC = infection prevention and control; PPE = personal protective equipment.

Perceived organizational preparedness

Respondents felt equivocal as to whether their work setting is able to manage current and future demand, responding less positively than on most other measures. Overall, 71% of respondents affirmed that current COVID-19 patient demand is being adequately managed, while only 33% affirmed that they believe the system will be able to manage demand over the next three months (Figure).

Trust in organizational preparedness to prevent infection

Bedside nurses had more trust in the organizational, provincial, and national preparedness than other workers did ($T = 3.74$; 95% CI, 3.26 to 10.64; $P < 0.001$) (Table 3). Older age was associated with higher trust in the system ($B = 0.31$, $P < 0.001$). Similarly, there was greater trust in the system among those further out from training ($F = 18.09$, $P < 0.001$), with mean trust scores (out of a maximum trust score of 63) ranging from 33.3 (12.1) among those in practice for less than 5 years to 42.8 (14.0) among those in practice for more than 20 years (ESM). Those with experience during previous outbreaks also had more trust ($F = 7.87$, $P = 0.005$) (Table 3). Our survey was distributed during the peak of Canada's first wave; however, whether respondents were personally caring for suspected/confirmed COVID-19 patients or working in hospitals that cared for suspected/confirmed COVID-19 patients did not change respondents' trust levels.

Discussion

Our survey of Canadian emergency and critical care nurses, early after the onset of the COVID-19 outbreak, shows high levels of trust in the healthcare system. While respondents felt comfortable with IPC procedures for general communicable diseases, they felt less comfortable with IPC procedures surrounding COVID-19. This difference potentially speaks to the emerging level of evidence surrounding COVID-19 and the early period of the pandemic captured by this study.

Nurses practicing in settings caring for COVID-19 patients felt confident in their IPC skills, potentially reflecting the emergence of IPC education and COVID-19 policies early in the pandemic in centres expecting to see COVID-19 cases. Overall, respondents showed strong beliefs regarding the importance of IPC and reported very strong social and professional expectations to follow IPC procedures, and perceived that following IPC procedures is part of their job. At the same time, respondents showed

beliefs that they have some autonomy and control over whether they become infected.

Our study showed a discord between intentions to use PPE and reported use: 96% of respondents agreed or strongly agreed that they intended to use PPE, while only 85% had actually used gowns and 86% had used a face shield when caring for suspected or confirmed COVID-19 patients. Thirty percent of respondents noted that they cannot easily access PPE. Combined, these findings speak to challenges accessing PPE early in the pandemic,^{26,27} particularly face shields.

Our finding that our nursing cohort felt a sense of control and noted high degrees of support from senior colleagues is in contrast to other literature showing that nurses are at high risk for burnout.²⁻⁵ In our study, which largely comprised front-line critical care and emergency nurses providing direct clinical care (though not exclusively), there was a strong sense of concern for personal health and risk to family; however, participants felt empowered and in control of their own situation. Having a sense of control has been correlated with lower rates of burnout,^{28,29} as has having strong support from managers among nurses.³⁰ Recent studies conducted during the COVID-19 outbreak have shown high degrees of burnout, anxiety, and depression among similar populations^{2,3,31}; while we did not specifically screen for these conditions, our findings do not appear to be in keeping with them, particularly as these feelings are often associated with a lack of a feeling of support and lack of feeling of control, which was not evident in our population.

Canadian nurses showed a high level of institutional trust in our survey. Intriguingly, older nurses, those more remote from their training, and those who had worked during previous epidemics, all had significantly higher trust in institutional systems, even though these nurses had higher levels of fear. While these findings could be due to statistical variation among the sub-group of older nurses, it may also reflect the high levels of societal fear of illness at the time of survey distribution, which was early in our experience and understanding of the disease. These HCWs, who are more experienced and perhaps more senior in the healthcare setting, trust the decision-making processes being made to prioritize their own safety. Nevertheless, their fear may stem from their perception of personal risk as a result of more advanced age and disease severity associated with older age.

As it relates to fear, it is notable that Canada's COVID-19 outbreak did not reach the same levels of those in other settings (e.g., Italy) during the initial wave of the pandemic; ongoing fear may be related to fear of the outbreak worsening, as shown by respondents' concern that the Canadian system will not have capacity to manage future caseloads. Fear in those with previous experience

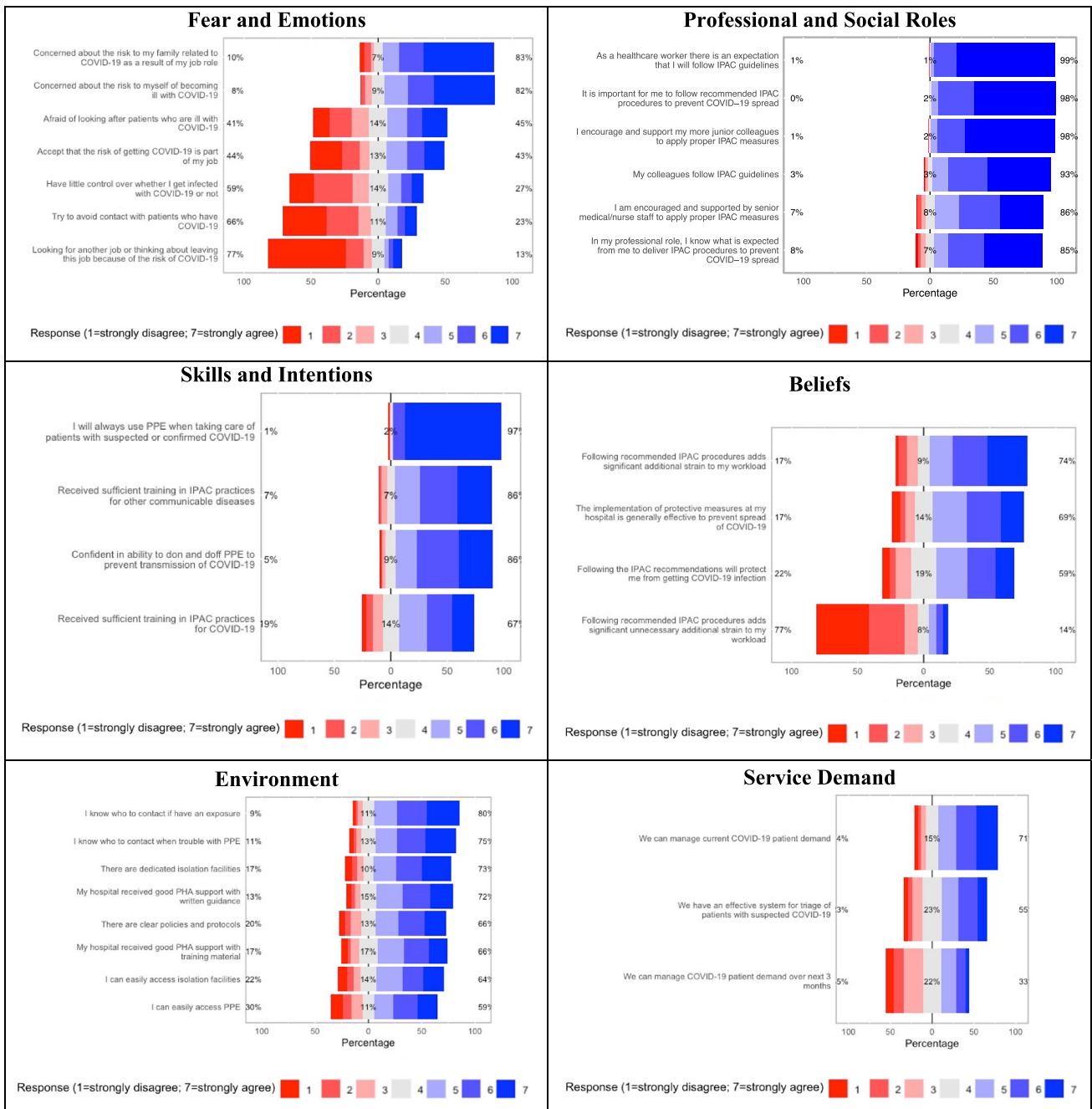


Figure Responses to individual Likert-scale questions by thematic category. *Figure description:* Responses to nine questions on a Likert scale of 1–7, with 1 representing strongly disagree and 7 representing strongly agree. Percentages on each question, from left to right, represent the percent who disagreed with the question (strongly

disagree, disagree, somewhat disagree), those who neither agreed nor disagreed (in grey bar), and those who affirmed the question (somewhat agree, agree, strongly agree).

working during outbreaks, despite adequate training, might be related to having worked in epidemic experiences before and having lingering fears from recent outbreaks such as SARS.^{32,33} Ongoing monitoring for fear, as well as long-term mental health impacts, will be important to capture beyond the initial outbreaks.

Future directions

Future work should focus on evaluating change in trust, beliefs, and skills during evolving pandemics, as well as linking specific healthcare policies and geographies to respondent beliefs. A more in-depth understanding of the influence systems and communication strategies on perspectives, particularly assessing leadership styles, media impact, and information sharing, would be informative in developing potential interventions to support HCWs in future pandemics.

Limitations

Our study is limited as we did not collect geographical data and are therefore unable to assess how responses changed in relation to the different timing of outbreaks across the country, as well as different local and provincial policies. Overall, our study's limited response rate may be related to the high volume of surveys and studies being initiated at the time of this study, with competing requests from other research groups and an emerging high clinical burden, as well as the listservs we were able to access for survey distribution. We sought to disseminate the survey quickly, early in the pandemic, to capture the rapidly changing healthcare landscape. Nevertheless, because of the resulting survey distribution, the majority of nursing respondents are based in critical care settings (ICU, emergency department); our findings therefore may not be generalizable to other nursing populations or other HCWs. Our gender skew, which likely reflects the high percentage of women in nursing, limited our ability to assess whether gender played a role in respondents' perspectives, which has been shown in other studies.^{3,34} Finally, our findings might reflect stated rather than actual experiences of respondents, which is a recognized limitation of survey methodology.³⁵

Conclusions

We conducted a survey of nurses in Canada during the early stages of the COVID-19 pandemic. Respondents expressed trust that the local, provincial, and national health system leadership will ensure protective measures are in place during the pandemic. Trust was highest among

bedside nurses, older nurses, those with more years of independent practice, and those with experience during previous epidemics, despite the same population reporting higher levels of fear of becoming ill. Canadian nurses had strong beliefs in the utility of PPE and IPC measures, and self-reported high rates of adherence to both IPC measures as well as PPE use. Canadian nurses showed strong social and professional expectations to adhere to IPC measures.

Author contributions Sarah L. Silverberg, Lisa M. Puchalski Ritchie, and Srinivas Murthy contributed to all aspects of this manuscript, including conception and design; acquisition, analysis, and interpretation of data; and drafting the article. Nina Gobat contributed to the conception and design of the study, to the interpretation of data, and drafting the article.

Disclosures None.

Funding statement This project was supported by funding from the Canadian Institute of Health Research, Grant #OV2-170359 (<https://cihr-irsc.gc.ca/e/193.html>). Srinivas Murthy reports institutional support from the Chair in Pandemic Preparedness Research from the Health Research Foundation and Innovative Medicines Canada. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Editorial responsibility This submission was handled by Dr. Sangeeta Mehta, Associate Editor, *Canadian Journal of Anesthesia/Journal canadien d'anesthésie*.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, which permits any non-commercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc/4.0/>.

References

1. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA* 2020; 323: 1061-9.
2. Lai J, Ma S, Wang Y, et al. Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw Open* 2020; DOI: <https://doi.org/10.1001/jamanetworkopen.2020.3976>.
3. Luo M, Guo L, Yu M, Jiang W, Wang H. The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public - a systematic review and meta-analysis. *Psychiatry Res* 2020; DOI: 10.1016/j.psychres.2020.113190.

4. Hu D, Kong Y, Li W, et al. Frontline nurses' burnout, anxiety, depression, and fear statuses and their associated factors during the COVID-19 outbreak in Wuhan, China: a large-scale cross-sectional study. *EClinicalMedicine* 2020; DOI: <https://doi.org/10.1016/j.eclinm.2020.100424>.
5. Fernandez R, Lord H, Halcomb E, et al. Implications for COVID-19: a systematic review of nurses' experiences of working in acute care hospital settings during a respiratory pandemic. *Int J Nurs Stud* 2020; DOI: <https://doi.org/10.1016/j.ijnurstu.2020.103637>.
6. Martin SD. Nurses' ability and willingness to work during pandemic flu. *J Nurs Manag* 2011; 19: 98-108.
7. Brooks SK, Dunn R, Amlot R, Rubin GJ, Greenberg N. A systematic, thematic review of social and occupational factors associated with psychological outcomes in healthcare employees during an infectious disease outbreak. *J Occup Environ Med* 2017; 60: 248-57.
8. Houghton C, Meskell P, Delaney H, et al. Barriers and facilitators to healthcare workers' adherence with infection prevention and control (IPC) guidelines for respiratory infectious diseases: a rapid qualitative evidence synthesis. *Cochrane Database Syst Rev* 2020; DOI: <https://doi.org/10.1002/14651858.CD013582>.
9. Barratt R, Gilbert GL, Shaban RZ, Wyer M, Hor SY. Enablers of, and barriers to, optimal glove and mask use for routine care in the emergency department: an ethnographic study of Australian clinicians. *Australas Emerg Care* 2020; 23: 105-13.
10. Borg MA, Waisfisz B, Frank U. Quantitative assessment of organizational culture within hospitals and its relevance to infection prevention and control strategies. *J Hosp Infect* 2015; 90: 75-7.
11. Cook TM. Personal protective equipment during the coronavirus disease (COVID) 2019 pandemic - a narrative review. *Anaesthesia* 2020; 75: 920-7.
12. Schwartz D, Shapira S, Bar-Dayyan Y. Health care workers' knowledge and confidence in personal protective equipment during the H1N1 pandemic in Israel. *Disaster Med Public Health Prep* 2014; DOI: <https://doi.org/10.1017/dmp.2014.25>.
13. Quinn SC, Parmer J, Freimuth VS, Hilyard KM, Musa D, Kim KH. Exploring communication, trust in government, and vaccination intention later in the 2009 H1N1 pandemic: results of a national survey. *Biosecur Bioterror* 2013; 11: 96-106.
14. Han Q, Zheng B, Cristea M, et al. Trust in government and its associations with health behaviour and prosocial behaviour during the COVID-19 pandemic. *PsyArXiv* 2020; DOI: <https://doi.org/10.31234/osf.io/p5gns>.
15. Bennett C, Khangura S, Brehaut JC, et al. Reporting guidelines for survey research: an analysis of published guidance and reporting practices. *PLoS Med* 2010; DOI: <https://doi.org/10.1371/journal.pmed.1001069>.
16. Burns KE, Duffett M, Kho ME, et al. A guide for the design and conduct of self-administered surveys of clinicians. *CMAJ* 2008; 179: 245-52.
17. World Health Organization. Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected: Interim guidance, first edition, 19 March 2020 2020. Available from URL: <https://www.who.int/publications/i/item/10665-331495> (accessed April 2021).
18. World Health Organization. COVID-19 social science working group terms of reference. Geneva, Switzerland: World Health Organization; 2020. Available from URL: https://www.who.int/docs/default-source/blue-print/socsci-tors.pdf?sfvrsn=770270b0_6&download=true (accessed April 2021).
19. World Health Organization. Perceptions of healthcare workers regarding local infection prevention and control procedures for COVID-19: research protocol. Geneva, Switzerland: World Health Organization; 2020. Available from URL: https://cdn.who.int/media/docs/default-source/blue-print/perceptions-of-healthcare-workers-protocol-v1-0.pdf?sfvrsn=3f0dd47c_4&download=true (accessed April 2021).
20. Michie S, Johnston M, Abraham C, et al. Making psychological theory useful for implementing evidence based practice: a consensus approach. *Qual Saf in Health Care* 2005; 14: 26-33.
21. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci* 2012; DOI: <https://doi.org/10.1186/1748-5908-7-37>.
22. Atkins L, Francis J, Islam R, et al. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implement Sci* 2017; DOI: <https://doi.org/10.1186/s13012-017-0605-9>.
23. Freimuth VS, Musa D, Hilyard K, Quinn SC, Kim K. Trust during the early stages of the 2009 H1N1 pandemic. *J Health Commun* 2014; 19: 321-39.
24. Government of Canada. COVID-19 daily epidemiology update. Available from URL: <https://health-infobase.canada.ca/covid-19/epidemiological-summary-covid-19-cases.html> (accessed April 2021).
25. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009; 42: 377-81.
26. Shah J, Ho J, Zhong A, et al. In a time of need: a grassroots initiative in response to PPE shortage in the COVID-19 pandemic. *Healthc Q* 2020; 23: 9-15.
27. Eggertson L. Canadian primary care doctors face shortage of protective equipment. *CMAJ* 2020; 192: E380-1.
28. Browning L, Ryan CS, Thomas S, Greenberg M, Rolniak S. Nursing specialty and burnout. *Psychol Health Med* 2007; 12: 148-54.
29. Southwick FS, Southwick SM. The loss of a sense of control as a major contributor to physician burnout: a neuropsychiatric pathway to prevention and recovery. *JAMA Psychiatry* 2018; 75: 665-6.
30. Hunsaker S, Chen HC, Maughan D, Heaston S. Factors that influence the development of compassion fatigue, burnout, and compassion satisfaction in emergency department nurses. *J Nurse Scholarsh* 2015; 47: 186-94.
31. Zhang WR, Wang K, Yin L, et al. Mental health and psychosocial problems of medical health workers during the COVID-19 epidemic in China. *Psychother Psychosom* 2020; 89: 242-50.
32. Maunder RG, Lancee WJ, Balderson KE, et al. Long-term psychological and occupational effects of providing hospital healthcare during SARS outbreak. *Emerg Infect Dis* 2006; DOI: <https://doi.org/10.3201/eid1212.060584>.
33. Verma S, Mythily S, Chan YH, Deslypere J, Teo EK, Chong SA. Post-SARS psychological morbidity and stigma among general practitioners and traditional Chinese medicine practitioners in Singapore. *Ann Acad Med Singap* 2004; 33: 743-8.
34. Azcona G, Bhatt A, Davies S, Harman S, Smith J, Whenham C. Spotlight on gender, COVID-19 and the SDGs: Will the pandemic derail hard-work progress on gender equality? NY, USA: UN Women; July 2020. Available from URL: <https://www.unwomen.org/en/digital-library/publications/2020/07/spotlight-on-gender-covid-19-and-the-sdgs> (accessed April 2021).
35. Rubenfeld GD. Surveys: an introduction. *Respir Care* 2004; 49: 1181-5.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.