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# Level of patient contact and Impact of Event scores among Canadian healthcare providers during the COVID-19 pandemic

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## Abstract

**Background** Healthcare providers (HCP) continue to provide patient care during the COVID-19 pandemic despite the known risks for transmission. Studies conducted early in the pandemic showed that factors associated with higher levels of distress among HCP included being of younger age, female, in close contact with people with COVID-19, and lower levels of education. The goal of this study was to determine if level of patient contact was associated with concern for post-traumatic stress disorder (PTSD) as measured by the Impact of Event Scale-Revised (IES-R).

**Methods** This cross-sectional study, embedded within a prospective cohort study, recruited HCP working in hospitals in four Canadian provinces from June 2020 to June 2023. Data were collected at enrolment and annually from baseline surveys with the IES-R scale completed at withdrawal/study completion. Modified Poisson regression was used to determine the association between level of patient contact and concern for PTSD (i.e., IES-R scores  $\geq 24$ ).

**Results** The adjusted rate ratio (RR) associated with concern for PTSD among HCP with physical contact/direct patient care was 1.19 (95% confidence interval (CI) 1.03, 1.38) times higher than for HCP with no direct contact. In fully adjusted linear regression models, physical care/contact was associated with higher avoidance and hyperarousal scores, but not intrusion scores.

**Conclusions** Administrators and planners need to consider the impact of heightened and ongoing stress among HCP by providing early screening for adverse emotional outcomes and delivery of tailored preventive strategies to ensure immediate and long-term HCP health.

**Keywords** Post-traumatic stress, Healthcare provider, COVID-19, IES-R

## Background

Transmission of the SARS-CoV-2 coronavirus has continued since the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) a pandemic on March 11, 2020 [1]. Due to the significant physical health impacts of COVID-19, attempts were made to slow viral transmission including quarantine restrictions and preventive methods such as wearing masks, social distancing, closing venues, and vaccination. However, such mitigation strategies, added to the threats of the

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disease itself, can increase disruption and trauma-related stress [2, 3].

Post-traumatic stress disorder (PTSD) is a common outcome after witnessing or experiencing a traumatic event [4]. In a 2002 Canadian study based on self-reported symptoms, Van Ameringen et al. found that prevalence of PTSD was 2.4% [5]. In a subsequent self-reported Canadian survey conducted between August and December 2021, the estimated prevalence of PTSD had increased to 5.4% [6]. Despite ongoing transmission, healthcare providers (HCP) need to provide optimal patient care. During the early pandemic period higher stress levels were reported by HCP secondary to increased workload, constantly changing work environments, provision of care to people with COVID-19, deaths caused by the disease, and fear of infecting themselves and their close contacts [7, 8].

Several studies [9–15] have used the Impact of Event Scale-Revised (IES-R) [16] to assess concern for PTSD during the COVID-19 pandemic. Among HCP, younger age, female gender, personal exposure to COVID-19, and lower levels of education have been identified as factors associated with higher levels of concern for PTSD [11, 14, 17]. However, these studies were conducted over short periods and/or early in the pandemic when some transmission mitigation strategies, such as quarantine measures and vaccines, had either not been employed or were not yet available.

This study aims to investigate the level of concern for PTSD, as measured by the IES-R, among Canadian HCP

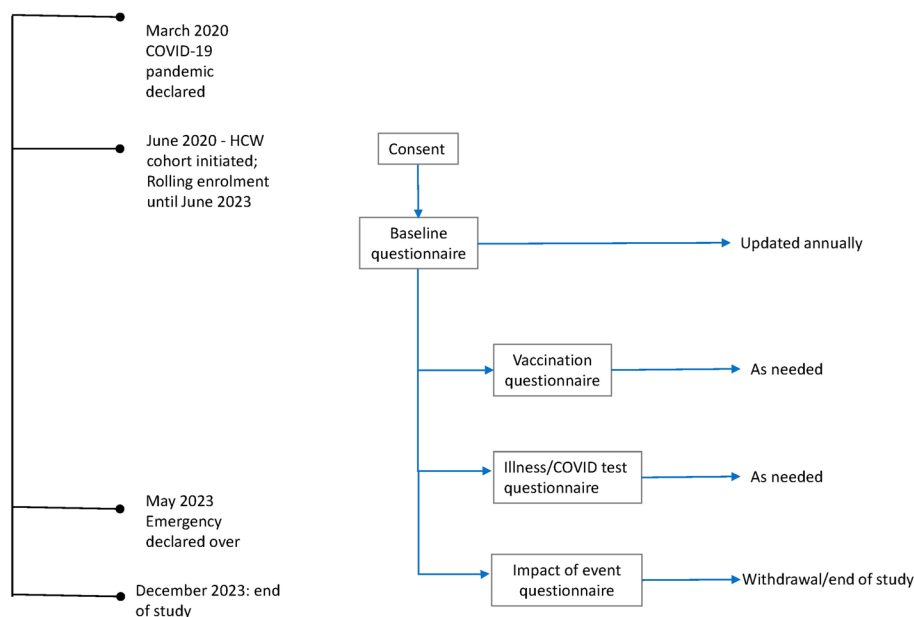
in relation to their level of contact with patients, adjusted for potential confounders, between June 10, 2021 and December 1, 2023. Levels of avoidance, intrusion, and hyperarousal are also explored.

**Methods**

**Study design**

The COVID-19 Cohort Study was a 3.5 year prospective cohort study following HCP from acute care, rehabilitation, and complex care hospitals in the greater Toronto area (Sinai Health, Sunnybrook Health Sciences Centre, Oak Valley Health (Markham Stouffville Hospital), North York General, Michael Garron Hospital, Unity Health (St. Michael’s Hospital), William Osler Health System, and University Health Network), Hamilton (St. Joseph’s Healthcare Hamilton, Hamilton Health Sciences Centre), Ottawa (The Ottawa Hospital), Alberta (Calgary Health Zone, Grey Nuns Community Hospital, University of Alberta Hospital), Quebec (Centre hospitalier universitaire de Sherbrooke), and Halifax (IWK Health Centre, QE II) as well as private physician or midwifery practices in the Toronto area. Rolling enrollment, from June 2020 to June 2023, occurred following ethical approval at each site.

Consented participants completed annual baseline surveys and illness and vaccination surveys as needed. Participants completed the IES-R once within two weeks of study withdrawal or at study closure (December 1, 2023) (see Fig. 1).



**Fig. 1** Study design and timeline

### Participants

Consented HCP were eligible for these analyses if they completed  $\geq 50\%$  of their most recent baseline questionnaire; were 18 to 75 years old, inclusive; were employed full- or part-time ( $>20$  h per week) by a participating hospital; or were a physician, midwife, or nurse practitioner with hospital privileges and who cared for ill patients  $\geq 8$  h per week. Participants with incomplete IES-R data were excluded from analyses.

### Outcome

The Impact of Event Scale (IES) is a 15-item measure of the frequency with which respondents experience thoughts and behaviours associated with two definitional symptoms of PTSD: intrusion and avoidance [18]. The scale was revised (IES-R) with the addition of another set of items designed to identify the frequency of hyperarousal symptoms [16]. The IES-R asks participants to indicate, on a scale from 0 (not at all) to 4 (extremely), how distressing each of 22 listed difficulties have been for them during the previous seven days. To orient participants, the survey was introduced with “You have been working throughout the COVID-19 pandemic”. Overall IES-R scores are the sum of all 22 items (range 0 to 88) and were interpreted using criteria developed by Weiss and Marmar [16] (0–23: no concern for PTSD;  $\geq 24$ : indicative of concern for PTSD). Subscale scores (avoidance, intrusion, hyperarousal) are the mean of the subscale item scores (range 0 to 4).

### Exposure

In the baseline survey, participants were asked to respond to three questions that asked them to indicate which of five levels of contact they had with inpatients, outpatients, and emergency department patients: 1) not applicable, no close contact with patients; 2) never or rarely in room or confined physical space with patients; 3) in room/confined space with patients, but not within 2 m of their face; 4) in room/confined space and within 2 m of their face, but no physical contact/care; 5) physical contact and/or care of patients. Two metres was selected as a key distance for this study as recommended by the Government of Canada to reduce transmission of COVID-19 [19]. The highest level of contact in any of the three settings was selected. The four levels of patient contact used in these analyses are: 1) no direct contact; 2) never/rarely in patient rooms; 3) in patient rooms but no contact, and 4) physical care/contact.

### Covariates

Baseline surveys collected demographic and work-related information including age; gender; self-reported health;

medications for anxiety, depression, or insomnia; occupation; and current work unit (high-risk: emergency department, adult intensive care unit, or adult inpatient medical unit vs low-risk: all others). COVID-19 vaccine receipt was obtained from the most recent vaccination questionnaire. The study did not use information from the illness/testing surveys.

A mitigation strategy measure that ranked the intensity of non-pharmacological mitigation strategies associated with three sectors (work, education, and other locations) on a four-point scale (0: no restrictions to 3: most stringent restrictions) was included as a study covariate [20]. The mutually exclusive categories developed by Akanteva et al. are specific to each sector (e.g., category 3: work: all non-essential workplaces closed or operating remotely, only essential services or businesses remain open; education: all schools closed for in-person instruction; other locations: stringent gathering restriction, border closures between provinces for non-essential travel, closure of all indoor activities, and closure of most outdoor activities) [20]. Periods when restrictions summed to  $\geq 7$  were identified as periods of high mitigation. Periods were determined using Ontario data. While other provinces imposed different restrictions at different times, Ontario was selected as the referent as most study sites were within this province.

### Data analysis

Chi-squared or Fisher's exact tests were used to compare categorical variables while t-tests or median tests were used to compare continuous variables, as appropriate. Modified Poisson regression was used to quantify the relationships between study variables and dichotomized IES-R scores [21]. All models were adjusted by age and gender. Other study covariates that were not associated with the outcome were sequentially eliminated as per Vittinghoff et al. [22]. Variance estimates were adjusted in multivariable models for clustering within province. The final model was assessed for goodness-of-fit and multi-collinearity. Linear regression, adjusted for clustering within provinces, was used to assess the association between subscale scores and variables found to be significant predictors of the dichotomized IES-R score.

## Results

### Participant characteristics

Of the 2648 HCP who participated in the parent study, 1498 (56.6%) submitted an IES-R between June 10, 2021 and December 1, 2023. Those who submitted an IES-R were significantly older, and less likely to be a nurse, work on a high-risk unit, or to have been working for less than five years compared with the full cohort (see Table 1).

**Table 1** Canadian healthcare provider characteristics of participation: COVID-19 Cohort Study (June 15, 2020–December 1, 2023) versus IES-R sub-study (June 10, 2021–December 1, 2023)

Variable	Full cohort study (N=2648)	IES-R sub-study (N=1498)	p-value <sup>1</sup>
Gender: Female	2279 (86.1)	1308 (87.3)	0.05
Male	360 (13.6)	190 (12.7)	
Other	9 (0.3)	0 (0.0)	
Age at enrolment, mean (95% CI)	41.1 (40.7, 41.6)	42.4 (41.9, 43.0)	<0.001
Education, highest completed			0.79
College diploma or less	667 (25.2)	369 (24.6)	
Bachelor's degree	1149 (43.4)	650 (43.4)	
Master's degree	468 (17.7)	278 (18.6)	
MD/PhD	362 (13.7)	201 (13.4)	
Missing	2 (0.1)	0	
Health status, self-reported			0.77
Poor/fair/good	610 (23.1)	343 (22.9)	
Very good	1250 (47.2)	723 (48.3)	
Excellent	788 (29.8)	432 (28.8)	
COVID-19 vaccination status			NA <sup>3</sup>
Incomplete		154 (10.3)	
Fully vaccinated <sup>2</sup>		1344 (89.7)	
Works on a high-risk unit <sup>4</sup>			<0.001
No	1777 (67.1)	1060 (70.8)	
Yes	837 (31.6)	434 (29.0)	
Missing	34 (1.3)	4 (0.3)	
Occupation			0.003
Nurse (NP/RN/RPN)/midwife	893 (33.7)	482 (32.2)	
Physician/physician assistant	283 (10.7)	152 (10.1)	
Other regulated HCP <sup>5</sup>	764 (28.9)	463 (30.9)	
Other <sup>6</sup>	684 (25.8)	401 (26.8)	
Missing	24 (0.9)	0	
Province of work			0.72
Ontario	1595 (60.2)	875 (58.4)	
Alberta	486 (18.4)	285 (19.0)	
Quebec	324 (12.2)	194 (13.0)	
Nova Scotia	243 (9.2)	144 (9.6)	
Highest level of patient contact			<0.001
No patient care	470 (17.7)	300 (20.0)	
Never/rarely in room	233 (8.8)	145 (9.7)	
Same room	489 (18.5)	280 (18.7)	
Physical care/contact	1430 (54.0)	773 (51.6)	
Missing	26 (1.0)	0	

HCP healthcare provider, NP Nurse practitioner, RN Registered nurse, RPN Registered practical nurse, NA Not applicable

<sup>1</sup> Pearson's chi-squared for binary/categorical variables, two-sided t-test for continuous variables

<sup>2</sup> See definition [23]

<sup>3</sup> No appropriate comparison available for the full-study population given that COVID-19 vaccination status was a time-varying factor

<sup>4</sup> Adult intensive care units, emergency departments, and adult inpatient medical units

<sup>5</sup> Respiratory therapist, laboratory technician, physical therapist, occupational therapist, imaging technician/technologist, pharmacist, pharmacy technician, psychologist, social worker

<sup>6</sup> Infection prevention and control practitioner, food service, ward clerk, administration, healthcare aid, housekeeper, porter, researcher, other clinical support

Almost one third of participants who completed the IES-R were nurses, nurse practitioners, or midwives, 773 (51.6%) provided physical care to patients, and 875 (58.4%) worked in the province of Ontario. The majority of participants were female (1309 or 87.3%) and had a mean age of 42.4 (95% confidence interval (CI) 41.9, 43.0) years. As gender was considered an important study covariate, those who selected “other” were dropped from analyses due to the small sample size.

The top three individual IES-R items most frequently assigned a score of 4, indicating that participants were extremely affected, were trouble staying asleep ( $n=48/1498$  or 3.2%), trouble falling asleep ( $n=42$ ), and trying not to think about it ( $n=39$ ). Meanwhile, few ( $n=6$ ) indicated they were extremely affected by reminders causing physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart.

As shown in Table 2, median IES-R scores, mean subscale scores, and the percent of respondents with an IES-R score indicative of concern for PTSD were similar in 2021 and 2022 but decreased significantly in 2023 ( $p < 0.001$ ).

#### Patient contact and concern for PTSD

As seen in Table 3, the unadjusted rate ratio (RR) associated with concern for PTSD among HCP with physical contact/care was 1.24 (95% CI 1.05–1.47) times higher than for HCP with no direct contact. When confounding variables were added, the adjusted RR associated with physical contact/care decreased by less than 5% to 1.19 (95% CI 1.03, 1.38).

#### Subscale scores

As shown in Table 2, the mean subscale scores were 0.87, 0.87, and 0.67 for avoidance, intrusion, and hyperarousal, respectively. As expected, given that subscale items are summed to create the overall IES-R score, the correlation

between the IES-R score and each subscale was 0.92 for both avoidance and hyperarousal and 0.96 for intrusion, with no differences in correlations by year of survey completion. There was also high correlation between the subscale scores at 0.88 for intrusion:hyperarousal, 0.79 for intrusion:avoidance, and 0.74 for hyperarousal:avoidance.

In fully adjusted linear regression models, physical care/contact was associated with increased avoidance and hyperarousal scores, but not intrusion scores. Being in the same room as a patient was also associated with higher avoidance scores.

#### Discussion

Provision of physical care during the COVID-19 pandemic was associated with increased concern for PTSD among Canadian HCP. Between June 10, 2021 and December 1, 2023, in adjusted regression models, HCP providing physical care to patients had IES-R scores that were higher than for those with no direct patient contact. Patient contact was also associated with increased avoidance and hyperarousal scores but not with intrusion scores.

The association between level of patient contact and emotional distress has been found in previous studies. During the 2003 severe acute respiratory syndrome (SARS) outbreak in Toronto, nurses who had longer contact with patients with SARS had higher distress scores [24]. Similar findings were reported very early in the COVID-19 pandemic (February 2020) in China where working in a frontline position (i.e., directly engaged in clinical activities with patients with elevated temperatures or confirmed to have COVID-19) was associated with significantly higher median IES-R scores (22.5) than those who were not (17.0) [13].

In this study, in 2023, 22.5% of HCP had scores indicative of concern for PTSD. This rate is significantly lower than the 47.8% with scores of concern in 2021 but is,

**Table 2** Crude IES-R and subscale scores for Canadian healthcare providers, June 10, 2021–December 1, 2023, by calendar year

Survey tool	2021 (Jun. 10 to Dec. 31) ( $n=268$ )	2022 (Jan. 1 to Dec. 31) ( $n=928$ )	2023 (Jan. 1 to Dec. 1) ( $n=302$ )	Overall ( $n=1498$ )
Total IES-R <sup>a</sup>	22 (9, 35)	21 (7, 34)	10 (2, 22)	18 (6, 32)
IES-R score $\geq 24$ <sup>b</sup>	128 (47.8%)	416 (44.8%)	68 (22.5%)	612 (40.8%)
Avoidance <sup>c</sup>	1.00 (0.25, 1.62)	1.00 (0.25, 1.75)	0.37 (0, 1.12)	0.87 (0.12, 1.62)
Intrusion <sup>c</sup>	1.12 (0.25, 1.75)	0.87 (0.31, 1.62)	0.50 (0.12, 1.12)	0.87 (0.25, 1.50)
Hyperarousal <sup>c</sup>	0.83 (0.33, 1.50)	0.83 (0.17, 1.50)	0.33 (0, 0.83)	0.67 (0.17, 1.33)

Median test for IES-R scores over time:  $p < 0.001$

<sup>a</sup> median (interquartile range) as IES-R scores were not normally distributed

<sup>b</sup> number (percent)

<sup>c</sup> mean (95% confidence interval)

**Table 3** Factor-specific and modified Poisson regression model estimates comparing IES-R scores of no concern (<24) versus of concern (≥24), Canadian healthcare providers (June 10, 2021–December 1, 2023)

	Factor-specific estimates (N=1498) RR (95% CI)	Adjusted model <sup>a</sup> (N=1498) RR (95% CI)
<i>Level of patient contact</i>		
No direct contact	Referent	Referent
Never/rarely in room	0.99 (0.76, 1.28)	0.96 (0.76, 1.20)
Same room	1.16 (0.95, 1.41)	1.12 (0.99, 1.28)
Physical contact/care	1.24 (1.05, 1.47)*	1.19 (1.03, 1.38)*
<b>Potentially confounding variables</b>		
<i>Works on a high-risk unit<sup>b,f</sup>: No</i>		
Yes	1.30 (1.15, 1.47) <sup>‡</sup>	1.23 (1.10, 1.37) <sup>‡</sup>
<i>Age (in years)<sup>f</sup></i>		
Gender <sup>f</sup> : Female	Referent	Referent
Male	0.82 (0.66, 1.01)	0.87 (0.78, 0.95)*
<i>Health status, self-reported<sup>f</sup></i>		
Poor/fair/good	Referent	Referent
Very good	0.84 (0.73, 0.96)*	0.85 (0.81, 0.89) <sup>‡</sup>
Excellent	0.71 (0.60, 0.84) <sup>‡</sup>	0.71 (0.62, 0.81) <sup>‡</sup>
<i>Household size (per person)<sup>f</sup></i>		
COVID-19 vaccination status <sup>f</sup>		NA
Incomplete	Referent	
Fully vaccinated	1.78 (1.33, 2.37)	
<i>Date of submission<sup>f</sup></i>		
2021, Jun. 10 to Dec. 31	Referent	Referent
2022, Jan. 1 to Dec. 31	0.94 (0.81, 1.08)	0.94 (0.70, 1.26)
2023, Jan. 1 to Dec. 1	0.47 (0.37, 0.60) <sup>‡</sup>	0.49 (0.32, 0.75) <sup>‡</sup>
<i>Mitigation<sup>c,f</sup>: Low level</i>		
High level	1.26 (0.96, 1.65)	NA
<i>Occupation<sup>f</sup></i>		
Nurse/NP/midwife	Referent	Referent
Physician/physician assistant	0.65 (0.51, 0.84) <sup>‡</sup>	0.78 (0.70, 0.87) <sup>‡</sup>
Other regulated professional <sup>d</sup>	0.75 (0.64, 0.87) <sup>‡</sup>	0.84 (0.74, 0.95)*
Other <sup>e</sup>	0.85 (0.73, 0.99)*	1.01 (0.87, 1.18)
<i>Education, highest achieved<sup>f</sup></i>		
Secondary/College diploma	Referent	NA
Bachelor's degree	1.00 (0.87, 1.16)	
Master's degree	0.88 (0.73, 1.07)	
MD or PhD	0.76 (0.60, 0.95)*	
<i>Antidepressant, anti-anxiety, or anti-insomnia medication<sup>f</sup></i>		
Not reported	Referent	NA
Reported	1.12 (0.98, 1.30)	

RR Rate ratio, NP Nurse practitioner, NA Not applicable

\*  $p < 0.05$ <sup>‡</sup>  $p < 0.001$ <sup>a</sup> Variance estimates were also adjusted for clustering within province<sup>b</sup> adult intensive care units, emergency departments, and adult inpatient medical units<sup>c</sup> Periods of time when multiple COVID-19 transmission mitigation strategies were imposed<sup>d</sup> Respiratory therapist, laboratory technician, physical therapist, occupational therapist, imaging technician/technologist, pharmacist, pharmacy technician, psychologist, social worker<sup>e</sup> Infection prevention and control practitioner, food service, ward clerk, administration, healthcare aide, housekeeper, porter, researcher, other clinical support<sup>f</sup> These variables are included in the adjusted modified Poisson regression model to reduce confounding in the relationship between level of patient contact and dichotomous IES-R scores and should not be interpreted as adjusted main effects, or predictors, in their own right

itself, substantially lower than estimates from other studies conducted with HCP that also used the IES-R with a cut-off score of  $\geq 24$ . In a Canadian study, 74% of critical care nurses had scores of concern [25] while in Italy, 65% of physicians and 71% of nurses had scores of concern [26]. However, the estimate from this study is in line with an earlier 2020 Ontario study that also used the IES-R with a cut-off score  $\geq 24$  that found 50% of HCP had scores suggestive of concern for PTSD [27].

Fattori et al. [28] reported that Italian HCP mean IES-R scores decreased from 22 in 2020/2021 to 13 in 2021/2022. Although the scores are similar to the current study, the decrease in scores occurred about a year earlier in the Italian study. In contrast, Th'ng and colleagues reported substantially lower percentages of emergency department HCP who had scores of concern than in our study, at 13.6–16.2% for 2020 through 2022 in their longitudinal single-centre study in Singapore, with no significant change over time [29].

Studies indicate that HCP have dealt with COVID-19 associated stress in many ways. One in four Canadian HCP reported drinking more in 2021 than before the COVID-19 pandemic [30] and Canadian adults who screened positive for PTSD were 3.5 times more likely than those with a negative screen to report increased cannabis use since the beginning of the pandemic [31]. Conversely, 70% of HCP indicated that they are exercising to improve or maintain their health during the pandemic [30]. Carmassi et al. reported that HCP with IES-R scores of  $\geq 24$  had significantly higher Work and Social Adjustment Scale [32] scores than HCP with lower scores [33], indicating interference in working, recreational, and social activities, household chores, and family relationships. A rapid review of successful strategies to reduce HCP stress indicated that actions need to be taken at the organizational level [34]. These authors suggest that communication needs to be timely and accurate, and that HCP safety and well-being needs to be kept in the forefront. Healthcare leaders should tailor stress reduction strategies to their population and prioritize HCP who are providing direct patient care.

As with all studies, this study has limitations. Non-random sampling methods were used to generate both the study and the sub-study populations; study participants were self-selected, and some did not complete the IES-R. Biases stemming from differential patterns of study enrollment or attrition could have led to under- or over-estimates of the relationship between level of patient contact and symptoms associated with concern for PTSD. It is unknown if we over- or under-sampled HCP with PTSD symptoms (% of participants with symptoms indicative of concern for PTSD; current study 2021: 47.8%; 2020 Honarmand et al. [27]: 50%; 2021 Crowe et al. [25]:

74%; 2021 Gorini et al.: 65% (physicians) [26]). In addition, the overall variance explained by all regression models was low which is likely due to unmeasured known (e.g., pre-existing mental illness [35], fear of COVID-19 [36], personality [37]), and unknown covariates/confounders/mediators. As well, all results are self-reported and may suffer from social desirability bias. Although we have no data from before (nor early) in the pandemic, one strength of the study is its longitudinal nature, with data from 2021 through 2023. Another strength is that participants were from four provinces across Canada, increasing generalizability.

## Conclusion

HCP who provided direct patient care were significantly more likely to have IES-R scores indicative of concern for PTSD than those reporting no direct patient contact. Healthcare system administrators and planners must consider the high prevalence of concern for PTSD among HCP who worked during the COVID-19 pandemic when reflecting on current human health resources. Early screening for adverse emotional outcomes during stressful times followed by the delivery of timely, tailored preventive strategies is vital for both immediate and long-term HCP health.

## Abbreviations

PTSD	Post-traumatic stress disorder
HCP	Healthcare provider
IES	Impact of Events Scale
IES-R	Impact of Events Scale-Revised
SARS	Severe acute respiratory syndrome
RR	Rate ratio

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12913-024-11426-w>.

Supplementary Material 1

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#### Authors' contributions

The authors confirm contribution to the paper as follows: conceptualization: BLC, RM, AM; data curation: BLC, IG, NR; formal analysis: BLC, NR; funding acquisition: BLC, AM, CCS Working Group; methods: BLC; project administration: BLC; resources: BLC, AM; supervision: BLC; validation: BLC, AS; original draft: AS, IG; review & editing: BLC, IG, AS, RM, AM, NR; approval of submitted version: IG, BLC, AS, NR, RM, AM, CCS Working Group; agree to be personally accountable for own contributions and to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated, resolved, and the resolution documented in the literature: IG, BLC, AS, NR, RM, AM, CCS Working Group

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#### Availability of data and materials

Study data cannot be shared openly. The datasets generated and/or analyzed during the current study are not publicly available due to information that could compromise the privacy of research participants. Data are available from the corresponding author on reasonable request.

#### Declarations

##### Ethics approval and consent to participate

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Research Ethics Boards of Sinai Health System (20–0080-E, 2020–04–17), Sunnybrook Health Sciences Centre (1644, 2020–04–13), Michael Garron Hospital (807–2004-Inf-055, 2020–04–29), North York General Hospital (20–0017, 2020–05–06), University Health Network (20–5368, 2020–05–21), Unity Health Toronto (20–109, 2020–06–01), Oak Valley Health (121–2010, 2020–11–04), William Osler Health System (2020–12–18), Hamilton Health Sciences Centre (12809, 2020–12–31), St. Joseph's Healthcare Hamilton (13044, 2020–12–31), University of Alberta (Pro00106776, 2021–01–13), Nova Scotia Health (1026317, 2021–02–02), The Ottawa Hospital (20210024-01H, 2021–02–05), and Centre hospitalier universitaire de Sherbrooke (MP-31–2021-4104, 2021–06–09).

Informed consent was obtained from all participants involved in the study.

##### Consent for publication

Not applicable.

##### Competing interests

The authors declare no competing interests.

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