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Original quantitative research

Support for health care workers and psychological distress: thinking about now and beyond the COVID-19 pandemic

Rima Styra, MD, MEd (1); Laura Hawryluck, MD, MSc (2); Allison McGeer, MD, MSc (3); Michelle Dimas, MSc (4); Eileen Lam, BPHE (1); Peter Giacobbe, MD, MSc (5); Gianni Lorello, MD (6); Neil Dattani, MD, DFCM (7); Jack Sheen, HBSc (8); Valeria E. Rac, MD, PhD (9,10); Troy Francis, MSc (10); Peter E. Wu, MD, MSc (11); Wing-Si Luk, MHSc (12); Jeya Nadarajah, MD, MSc (13); Wayne L. Gold, MD (3,11)

This article has been peer reviewed.

Abstract

Introduction: This study explores the relationship between emotional support, perceived risk and mental health outcomes among health care workers, who faced high rates of burnout and mental distress since the beginning of the COVID-19 pandemic.

Methods: A cross-sectional, multicentred online survey of health care workers in the Greater Toronto Area, Ontario, Canada, during the first wave of the COVID-19 pandemic evaluated coping strategies, confidence in infection control, impact of previous work during the 2003 SARS outbreak and emotional support. Mental health outcomes were assessed using the Generalized Anxiety Disorder scale, the Impact of Event Scale – Revised and the Patient Health Questionnaire (PHQ-9).

Results: Of 3852 participants, 8.2% sought professional mental health services while 77.3% received emotional support from family, 74.0% from friends and 70.3% from colleagues. Those who felt unsupported in their work had higher odds ratios of experiencing moderate and severe symptoms of anxiety (odds ratio [OR] = 2.23; 95% confidence interval [CI]: 1.84–2.69), PTSD (OR = 1.88; 95% CI: 1.58–2.25) and depression (OR = 1.88; 95% CI: 1.57–2.25). Nearly 40% were afraid of telling family about the risks they were exposed to at work. Those who were able to share this information demonstrated lower risk of anxiety (OR = 0.58; 95% CI: 0.48–0.69), PTSD (OR = 0.48; 95% CI: 0.41–0.56) and depression (OR = 0.55; 95% CI: 0.47–0.65).

Conclusion: Informal sources of support, including family, friends and colleagues, play an important role in mitigating distress and should be encouraged and utilized more by health care workers.

Keywords: *posttraumatic stress disorder, PTSD, depression, anxiety, support, infection control, burnout, mental health, psychological support, health care workers*

Highlights

- Health care workers mainly used informal sources of emotional support such as family, friends and colleagues during the current COVID-19 pandemic, with fewer seeking support from mental health professionals.
- Those health care workers who felt confident about the effectiveness of infection control measures, and particularly organizational policies, reported less overall distress.
- Health care workers who felt supported had reduced rates of hypnotic medication and alcohol use.
- Feelings of anxiety may have affected health care workers' ability to share information with their families about their risk of contracting COVID-19 at work.

Introduction

The COVID-19 pandemic has taken a toll on health care workers' physical and mental well-being.[1-3] The distress observed is similar to that previously seen during outbreaks of severe acute respiratory syndrome

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Author references:

1. Centre for Mental Health, University Health Network, Toronto, Ontario, Canada
2. Critical Care Medicine, University Health Network, Toronto, Ontario, Canada
3. Division of Infectious Diseases, University Health Network and Sinai Health System, Toronto, Ontario, Canada
4. Department of Research, William Osler Health System, Brampton, Ontario, Canada
5. Department of Psychiatry, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada
6. Department of Anesthesia and Pain Management, University Health Network, Toronto, Ontario, Canada
7. Department of Emergency and Urgent Care, William Osler Health System, Brampton, Ontario, Canada
8. Institute of Medical Science, University of Toronto, Toronto, Ontario, Canada
9. Peter Munk Cardiac Centre, University Health Network, Toronto, Ontario, Canada
10. Toronto Health Economics and Technology Assessment (THETA) Collaborative, University of Toronto, Toronto, Ontario, Canada
11. Division of General Internal Medicine, University Health Network, Toronto, Ontario, Canada
12. Patient Safety and Quality Improvement, University Health Network, Toronto, Ontario, Canada
13. Division of Infectious Diseases, Markham Stouffville Hospital, Markham, Ontario, Canada

Correspondence: Rima Styra, Centre for Mental Health, University Health Network, 200 Elizabeth Street, Suite 8EN-219, Toronto, ON M5G 2C4; Tel: 416-340-4825; Email: rima.styra@uhn.ca

(SARS), Middle East respiratory syndrome (MERS) and Ebola virus disease.[4-7] Recently, many health care workers have chosen to leave their jobs, which compromises the system's ability to provide care and prepare for any future surges of the pandemic or other health crises. Consequently, there is an urgent need to better understand the nature and scope of available supports and their ability to mitigate health care workers' distress as the pandemic continues.[8]

Emotional and social support is effective in mitigating depression, anxiety and other psychological distress related to traumatic events.[9,10] Support can be formal, such as instrumental and informational support from health care organizations and mental health professionals, and informal, namely the psychological support of family, friends and colleagues. During the COVID-19 pandemic, lack of perceived support has resulted in the predicted levels of poor psychological outcomes.[11,12] While the stress experienced by health care workers during this pandemic has been recognized[3,13,14], we need a better understanding of the optimal forms of support to address it.

Our study is descriptive and exploratory, and aims to identify the impact of emotional and instrumental support, such as infection control measures aimed at protecting health care workers.

Methods

Mental health outcomes based on measures of anxiety, posttraumatic stress disorder (PTSD) and depression during the COVID-19 pandemic have been detailed elsewhere.[15] Styra et al.[15] observed that a substantial proportion of health care workers experienced moderate or severe symptoms of PTSD (50.2%), anxiety (24.6%) and depression (31.5%). Multivariable logistic regression analysis showed that non-clinical health care workers had greater odds of experiencing anxiety (OR = 1.68; 95% CI: 1.19–2.15, $p = 0.01$) and depressive symptoms (2.03; 1.34–3.07; $p < 0.001$) than nurses, physicians and allied health care workers.[15]

Survey administration

We used a cross-sectional, multicentred, hospital-based online survey of health care workers at two tertiary and two community care hospitals in the Greater Toronto Area (Ontario, Canada) where patients with COVID-19 were treated. All personnel working at each of the four hospitals were invited via internal communications email to participate in the survey. Two reminders were sent each week over the two-week study period. This survey was adapted from one that we used during the 2003 SARS outbreak[6] to evaluate health care workers' mental health and the impact of infection control measures during the COVID-19 pandemic.

Data collection occurred during the first wave of the COVID-19 pandemic in the Greater Toronto Area, from 14 to 28 May 2020 for two centres, from 27 May to 10 June 2020 for the third centre, and from 19 June to 3 July 2020 for the fourth centre.

Ethics approval

Ethics approval was obtained for all sites from Clinical Trials Ontario (CTO #3189) and each site's institutional ethics review board.

Study population

All personnel working at each of the four hospitals were eligible to complete the survey. We categorized health care workers into four groups: nurses; physicians; allied health professionals (e.g. pharmacists, physiotherapists, occupational therapists, social workers); and non-clinical health care workers (e.g. administrative staff, research employees, environmental services).

Outcomes and measures

The survey included questions identifying dimensions of support, such as use of mental health resources and informal supports, for example, family, colleagues and friends. We assessed perception of personal and occupational risk and personal coping strategies as well as perception of the effectiveness of standard institutional infection prevention measures.

A number of survey questions asked health care workers about their perception of how infection control measures affected them during the COVID-19 pandemic. An example statement stated "I believe that the following measures are useful in protecting me from getting COVID-19," with the followed choices: "screening of patients and hospital visitors at entrance"; "all health care workers wearing masks in clinical areas"; "alcohol hand rinse"; "regular hand washing"; "learning as much as I can about COVID-19"; and "adhering to protocols and recommended measures."

An example question about support was phrased, "I have been receiving emotional support from…" with the following choices: "mental health professional"; "family"; "friends"; "colleagues"; or "I'm managing well on my own."

Statements on the impact of COVID-19 stemming from the workplace included "I am afraid of telling my family about the risk I am exposed to" or "I feel supported because of the work that I do as a health care worker." Health care workers who had worked during the 2003 SARS outbreak in the Greater Toronto Area were asked to self-identify to assess the impact of previous work experience during an emerging novel pathogen outbreak.

Primary mental health outcomes of symptoms of anxiety, PTSD and depression were assessed by validated self-report instruments: the 7-item Generalized Anxiety Disorder (GAD-7) scale for anxiety; the 22-item Impact of Event Scale – Revised (IES-R) for PTSD, made up of subscales on intrusion, avoidance and hyperarousal; and the 9-item Patient Health Questionnaire (PHQ-9) for measures of depression. In addition, we used cut-off scores to identify moderate and severe symptoms (GAD-7 = 10/15[16]; IES-R = 24/33[17]; and PHQ-9 = 10/15[18]), with higher scores indicating greater severity of symptoms.

Statistical analysis

We used statistical package R version 3.6.2 (R Foundation for Statistical Computing, Vienna, AT) to analyze collected data. Pearson chi-square tests were used to analyze categorical variables across groups, and Kruskal-Wallis rank sum tests to compare the severity of symptoms between groups. The significance level for each analysis was set at $\alpha = 0.05$, and all tests were 2-tailed. Statistical significance was set at 0.001.

We used overall domain scores for each analysis (GAD-7, IES-R and PHQ-9). Mental health outcome measures were not normally distributed and are reported as medians with interquartile ranges. Imputation was only used for a small number of demographic survey items (less than 10% missing at random) that were needed to power the multivariable logistic regression analysis. Demographic and descriptive frequency tables were reported as is and did not use any imputed data. Multivariable logistic regression analyses were performed on previous univariable models; these were shown to be significant and were adjusted for age, gender, type of health care work, hypnotic medication use, alcohol use and work experience during the 2003 SARS outbreak in Toronto.

Results

Demographics

The participants who completed the survey (N = 3852) comprised nurses (n = 1298; 33.6%), non-clinical health care workers (n = 1122; 29.1%), allied health staff (n = 1075; 27.9%) and physicians (n = 357; 9.3%). The majority (84.2%) identified as female, and just over half (55.6%) were married (Table 1).

Emotional support

A small percentage of health care workers (8.2%; n = 266) sought professional mental health support. However, the majority relied on using a number of different informal supports such as family (77.3%; n = 2649), friends (74.0%; n = 2496) and colleagues (70.3%; n = 2347).

Health care workers who sought support from mental health professionals scored significantly higher on symptoms of anxiety, PTSD and depression (Table 2) than those who did not seek professional support. There were no differences in seeking professional mental health support among the different categories of health care workers. Nurses (79%; n = 905) and allied health staff (71.5%; n = 681) sought emotional support from colleagues more frequently than did non-clinical health care workers (60.4%; n = 549) and physicians (62.5%; n = 207) ($p < 0.001$). Female health care workers sought support from family (79%; n = 2248), friends (76.8%; n = 2148) and colleagues (73.7%; n = 2038) more frequently than did their male colleagues ($p < 0.001$). Health care workers who had worked during the 2003 SARS outbreak (73.9%; n = 719) turned to colleagues more often than those who had not been employed in the field during that time (68.9%; n = 1622; $p < 0.004$) (data not shown).

TABLE 1
Demographic and occupational characteristics of health care workers who participated in the study of mental health supports during the first wave of the COVID-19 pandemic, May–July 2020, Greater Toronto Area, Ontario, Canada

Characteristic	n (%)				
	Allied health (n = 1075)	Nurses (n = 1298)	Physicians (n = 357)	Non-clinical (n = 1122)	Total (N = 3852)
Sex					
Male	161 (15.7)	111 (9.0)	153 (44.6)	147 (14.4)	572 (15.8)
Female	864 (84.3)	1126 (91.0)	190 (55.4)	875 (85.6)	3055 (84.2)
Age, years					
18–25	47 (4.7)	120 (9.8)	3 (0.9)	53 (5.3)	223 (6.2)
26–35	376 (37.6)	404 (33.0)	81 (23.5)	262 (26.1)	1123 (31.5)
36–45	262 (26.2)	300 (24.5)	118 (34.3)	251 (25.0)	931 (26.1)
46–55	219 (21.9)	229 (18.7)	75 (21.8)	270 (26.9)	793 (22.2)
>55	96 (9.6)	170 (13.9)	67 (19.5)	166 (16.6)	499 (14.0)
Marital status					
Married	563 (54.7)	656 (52.6)	261 (75.7)	552 (53.5)	2032 (55.6)
Unmarried	406 (39.4)	506 (40.6)	77 (22.3)	377 (36.5)	1366 (37.4)
Divorced/widowed	61 (5.9)	84 (6.7)	7 (2.0)	103 (10.0)	255 (7.0)
Education					
College/university	177 (36.8)	259 (42.6)	13 (9.4)	248 (50.1)	697 (40.5)
Professional/graduate	300 (62.4)	341 (56.1)	123 (89.1)	236 (47.7)	1000 (58.1)
Worked during 2003 SARS outbreak					
No	781 (73.1)	922 (71.2)	232 (65.2)	786 (70.3)	2721 (70.9)
Yes	287 (26.9)	373 (28.8)	124 (34.8)	332 (29.7)	1116 (29.1)

Abbreviation: SARS, severe acute respiratory syndrome.

Approximately 40% of health care workers (n = 1367) reported being afraid of disclosing to family the risk they were exposed to at work, with no difference between men and women. Those who expressed an inability to discuss their risk with family had significantly higher scores on all measures of psychological distress ($p < 0.001$) (Table 3).

Health care workers' decisions to inform their families of their risk was not influenced by whether they felt emotionally supported by the families. Physicians were more likely to share this information with their families (67.0%; n = 219) than were nurses (54.6%; n = 641) ($p < 0.001$) (data not shown).

Nearly two-thirds (63.8%; n = 653) of participants who had worked during the 2003 SARS outbreak felt comfortable sharing the level of risk with their families ($p < 0.001$) versus 56.9% (n = 1424) of those who had not worked during that outbreak (data not shown).

Coping strategies

Most participants (90.5%; n = 3143) expressed interest in learning about COVID-19 ($p < 0.001$). More than half reported coping by accepting their perceived risk (66.2%), by trying not to think about the risk (66%) and by keeping their minds positive (93.1%) (data not shown). There were significant differences in risk perceptions across the occupations. Higher proportions of non-clinical health care workers (58%; n = 494) than other groups of health care workers avoided colleagues caring for patients with COVID-19 (Table 4).

A small percentage of participants (10.9%; n = 333) were considering other employment or resigning. As many as 15.7% (n = 160) of nurses considered changing employment compared to 9.4% of non-clinical health care workers (n = 78),

TABLE 2

Support from mental health professionals, family, friends or colleagues or managing on their own and participants' GAD-7, IES-R and PHQ-9 scores during the first wave of the COVID-19 pandemic, May–July 2020, Greater Toronto Area, Ontario, Canada

Outcome[a,b]	Mental health professional			Family			Friends			Colleagues			Managing on their own		
	No (n = 2978)	Yes (n = 266)	*p*-value	No (n = 779)	Yes (n = 2649)	*p*-value	No (n = 878)	Yes (n = 2496)	*p*-value	No (n = 991)	Yes (n = 2347)	*p*-value	No (n = 795)	Yes (n = 2499)	*p*-value
GAD-7 total															
Median	5.00	8.00	<0.001	4.00	5.00	<0.001	4.00	5.00	<0.001	5.00	5.00	0.002	10.00	4.00	<0.001
IQR	1.00–9.00	4.50–15.00		0.00–8.75	2.00–10.00		0.00–8.00	2.00–10.00		1.00–9.00	2.00–10.00		6.00–15.00	1.00–7.00	
IES avoidance															
Median	8.00	11.00	<0.001	7.00	9.00	<0.001	7.00	9.00	<0.001	8.00	9.00	<0.001	12.00	7.00	<0.001
IQR	4.00–14.00	6.00–15.00		3.00–14.00	4.00–14.00		2.00–13.00	5.00–14.00		3.00–14.00	4.00–14.00		8.00–17.00	3.00–13.00	
IES intrusion															
Median	8.00	13.00	<0.001	7.00	9.00	<0.001	6.00	9.00	<0.001	7.00	9.00	<0.001	16.00	7.00	<0.001
IQR	4.00–15.00	7.00–19.00		2.00–14.00	5.00–16.00		2.00–14.00	5.00–16.00		2.00–15.00	4.00–15.00		9.00–21.00	3.00–12.00	
IES hyperarousal															
Median	5.00	10.00	<0.001	5.00	6.00	<0.001	4.50	6.00	<0.001	5.00	6.00	<0.001	11.00	4.00	<0.001
IQR	2.00–10.00	5.00–15.00		1.00–10.00	3.00–11.00		1.00–10.00	3.00–11.00		1.00–10.00	2.00–11.00		6.50–16.00	2.00–8.00	
IES-R total															
Median	23.00	34.00	<0.001	18.00	25.00	<0.001	18.50	25.00	<0.001	20.00	24.00	<0.001	39.00	19.00	<0.001
IQR	11.00–38.00	19.00–48.00		7.00–37.00	13.00–40.00		7.00–36.00	13.00–40.00		8.00–38.00	12.00–39.00		26.00–52.00	9.00–33.00	
PHQ-9 total															
Median	6.00	10.00	<0.001	5.00	6.00	0.002	5.00	7.00	<0.001	6.00	6.00	0.059	12.00	5.00	<0.001
IQR	2.00–11.00	5.00–16.00		1.00–12.00	3.00–11.00		1.00–12.00	3.00–11.00		2.00–12.00	3.00–11.00		7.00–18.00	2.00–9.00	

Abbreviations: GAD-7, 7-item Generalized Anxiety Disorder scale; IES-R, 22-item Impact of Event Scale – Revised; PHQ-9, 9-item Patient Health Questionnaire.

[a] Higher median scores for each scale mean more symptoms of the items being measured, i.e. of anxiety, PTSD or depression.

[b] Kruskal-Wallis rank sum test.

TABLE 3
Association between healthcare workers' fear of informing family of perceived risk and participants' GAD-7, IES-R and PHQ-9 scores during the first wave of the COVID-19 pandemic, May–July 2020, Greater Toronto Area, Ontario, Canada

Outcome[a,b]	Fear No (n = 2016)	Fear Yes (n = 1367)	*p*-value
GAD-7 total			
Median	4.00	7.00	<0.001
IQR	1.00–8.00	3.00–11.00	
IES-R total			
Median	19.00	30.00	<0.001
IQR	9.00–34.00	16.00–46.00	
PHQ-9 total			
Median	5.00	8.00	<0.001
IQR	2.00–10.00	4.00–13.00	

Abbreviations: GAD-7, 7-item Generalized Anxiety Disorder scale; IES-R, 22-item Impact of Event Scale – Revised; PHQ-9: 9-item Patient Health Questionnaire.

[a] Higher median scores for each scale mean more symptoms of the items being measured, i.e. of anxiety, PTSD or depression.

[b] Pearson chi-square test.

8.6% of allied health professionals (n = 76) and 5.9% of physicians (n = 19) ($p < 0.001$) (data not shown).

A large proportion (72.5%; n = 2452) felt supported because of their work as a health care worker. Those who felt unsupported had significantly higher odds of experiencing moderate and severe symptoms of psychological distress on multivariable logistic regression analysis: anxiety (OR = 2.23; 95% CI: 1.84–2.69; $p < 0.001$), PTSD (1.88; 1.58–2.25; $p < 0.001$) and depression (1.88; 1.57–2.25). Health care workers who did not feel supported because of the work they do were also at an increased risk for hypnotic use and likelihood of experiencing moderate to severe symptoms of anxiety (3.42; 2.71–4.34), depression (3.84; 3.04–4.85) and PTSD (4.24; 3.24–5.55). Similarly, alcohol use and feeling unsupported were associated with moderate to severe anxiety (1.89; 1.55–2.30), PTSD symptoms (2.12;

TABLE 4
Participants' coping strategies by occupation, sex and work experience during the 2003 SARS outbreak during the first wave of the COVID-19 pandemic, May–July 2020, Greater Toronto Area, Ontario, Canada

Question	n (%)[a] Occupation Non-clinical (n = 1122)	Allied health (n = 1075)	Nurses (n = 1298)	Physicians (n = 357)	*p*-value	Sex Male (n = 572)	Female (n = 3055)	*p*-value	2003 SARS outbreak experience No (n = 2726)	Yes (n = 1122)	*p*-value
Learning as much as I can about COVID-19											
Agree	873 (91.4)	876 (88.9)	1084 (91.1)	301 (89.9)	0.226	488 (90.9)	2579 (90.4)	0.729	2186 (89.3)	945 (93.3)	<0.001
Taking nutritional supplements, vitamins or probiotics											
Agree	511 (57.4)	473 (50.0)	709 (61.2)	78 (23.9)	<0.001	203 (39.3)	1526 (55.8)	<0.001	1227 (52.1)	545 (56.5)	0.023
Adhering to protocols and recommended measures											
Agree	946 (99.0)	978 (99.1)	1183 (99.5)	332 (98.8)	0.447	532 (99.3)	2832 (99.1)	0.766	2424 (99.0)	1009 (99.6)	0.066
Just accepting the inherent risk											
Agree	632 (67.2)	688 (70.3)	714 (60.6)	236 (70.9)	<0.001	387 (72.6)	1836 (65.0)	<0.001	1630 (67.2)	637 (63.6)	0.042
Trying not to think about the risk											
Agree	652 (68.6)	663 (67.3)	760 (64.2)	203 (60.6)	0.023	339 (63.2)	1900 (66.7)	0.117	1627 (66.8)	647 (63.9)	0.107
I am afraid of telling my family about the risk I am exposed to											
Agree	324 (35.7)	400 (41.3)	532 (45.4)	108 (33.0)	<0.001	199 (37.5)	1137 (41.0)	0.126	1025 (43.1)	339 (34.1)	<0.001
Keeping my mind positive											
Agree	896 (93.9)	918 (93.4)	1090 (92.5)	307 (92.5)	0.550	492 (92.5)	2653 (93.3)	0.483	2260 (92.9)	947 (93.7)	0.433
Avoiding crowded places / not going out in public											
Agree	900 (94.5)	930 (94.3)	1110 (94.1)	309 (92.8)	0.696	503 (94.2)	2673 (94.1)	0.899	2291 (94.0)	952 (94.4)	0.730
Avoiding colleagues who worked or are working with patients with COVID-19											
Agree	494 (58.0)	353 (38.5)	433 (37.6)	78 (23.7)	<0.001	187 (36.0)	1140 (42.9)	0.004	971 (42.4)	386 (40.4)	0.278
Hypnotics for sleep											
Agree	143 (15.1)	106 (10.9)	229 (19.3)	28 (8.5)	<0.001	52 (9.7)	447 (15.6)	<0.001	351 (14.5)	153 (15.1)	0.612
Started/increased alcohol use											
Agree	254 (26.3)	262 (26.4)	325 (27.5)	843 (25.0)	0.793	147 (27.0)	767 (26.6)	0.826	671 (27.4)	253 (24.9)	0.137

Abbreviation: SARS, severe acute respiratory syndrome.

[a] Pearson chi-square test.

1.76–2.56) and depression (2.07; 1.72–2.49). Health care workers who were able to tell their families about their perceived at-work risk demonstrated lower rates of moderate to severe anxiety (0.58; 0.48–0.69), symptoms of PTSD (0.48; 0.41–0.56) and symptoms of depression (0.55; 0.47–0.65) (see Table 5).

Infection control measures

Health care workers who did not consider the available personal protection equipment (PPE) sufficient protection were more likely to experience anxiety (OR = 1.74; 95% CI: 1.40–2.18; $p < 0.001$), symptoms of PTSD (1.84; 1.49–2.26; $p < 0.001$) and depression (2.10; 1.70–2.58; $p < 0.001$) (Table 5). Participants who were not confident with the screening processes for patients and visitors at the hospital entrances also had higher rates of anxiety (1.65; 1.30–2.10; $p < 0.001$), symptoms of PTSD (1.44; 1.16–1.80; $p < 0.001$) and depression (1.69; 1.35–2.11; $p < 0.001$).

In addition, those who disagreed with the adequacy of the infection control measures in place (adequate PPE and screening of patients and hospital visitors) were more likely to experience moderate to severe scores on all outcome measures (Table 5). Elevated rates of psychological distress were also observed among health care workers who disagreed with the effectiveness of routine handwashing (depression: OR = 2.67, 95% CI: 1.10–6.47, $p < 0.03$) and alcohol hand rinse use (anxiety: OR = 1.67, 95% CI: 1.09–2.58, $p < 0.02$; symptoms of PTSD: OR = 1.19, 95% CI: 1.27–2.90, $p < 0.002$; depression: OR = 1.72, 95% CI: 1.14–2.59, $p < 0.01$).

Discussion

Our study found that health care workers used a variety of psychological supports during the COVID-19 pandemic, with about three-quarters seeking emotional support from their families (77.3%), friends (74.0%) and colleagues (70.3%). Approximately 8% sought formal mental health support. Their use of formal mental health supports may relate to several factors: self-identification of severe psychological distress requiring intervention; pre-existing relationships with mental health supports; or prior mental health concerns that were exacerbated by social restrictions and workplace challenges during the COVID-19 pandemic.

The overall low rate of accessing mental health supports may be a result of difficulties accessing these supports because of long work hours as well as the stigma associated with requesting or needing mental health support. Alternatively, health care workers may feel they get adequate informal support from colleagues, family and friends and only turn to the available professional mental health supports if they have greater psychological distress. Health care workers may experience more psychological distress as a result of the lack of support, and those with high psychological distress may be more likely to perceive the available support to be inadequate.

Other studies of health care workers during the COVID-19 pandemic mirror our findings of the vital importance of the support of family, friends and colleagues. Family support has been shown to alleviate feelings of isolation and promote positive mental health[19], whereas the lack of social support from family and friends is associated with higher levels of anxiety, symptoms of PTSD and depression[11] and greater risk of burnout[12]. Support from colleagues has previously been shown to be associated with resilience, which is a protective factor against psychological distress.[20,21] Participants who had worked during the 2003 SARS outbreak were more likely to report seeking support from colleagues. As the SARS outbreak occurred almost 20 years ago, health care workers still working through the COVID-19 pandemic may be more established in their workplaces, with a stable and extensive network of supportive colleagues. Health care workers who treated people with COVID-19 built a stronger camaraderie with colleagues as a result of their shared experience.[22] This may be similar to shared experiences of working during the 2003 SARS outbreak in helping to mitigate distress.

Those health care workers who reported that they had talked about their perceived risk with family had lower scores for

TABLE 5
Multivariate logistic regression analysis of support and infection control measures on participants' moderate/severe mental health outcomes during the first wave of the COVID-19 pandemic, May–July 2020, Greater Toronto Area, Ontario, Canada

Variable	I feel supported because of the work that I do as a health care worker		I am afraid of telling my family about the risk I am exposed to		Available PPE is sufficient to protect me		Screening of patients and hospital visitors at entrance is useful	
	Adjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
GAD-7								
Disagree	2.23 (1.84–2.69)	<0.001	0.58 (0.48–0.69)	<0.001	1.74 (1.40–2.18)	<0.001	1.65 (1.30–2.10)	<0.001
Age, years								
18–45 (Ref.)	–	–	–	–	–	–	–	–
46–59	0.61 (0.49–0.78)	<0.001	0.60 (0.48–0.76)	<0.001	0.63 (0.50–0.79)	<0.001	0.62 (0.49–0.78)	<0.001
60+	0.53 (0.39–0.71)	<0.001	0.54 (0.40–0.73)	<0.001	0.52 (0.38–0.70)	<0.001	0.51 (0.38–0.69)	<0.001
Sex								
Male (Ref.)	–	–	–	–	–	–	–	–
Female	1.50 (1.14–1.98)	0.004	1.48 (1.13–1.95)	0.005	1.50 (1.14–1.97)	0.004	1.50 (1.14–1.97)	0.004

Continued on the following page

TABLE 5 (continued)
Multivariate logistic regression analysis of support and infection control measures on participants' moderate/severe mental health outcomes during the first wave of the COVID-19 pandemic, May–July 2020, Greater Toronto Area, Ontario, Canada

Variable	I feel supported because of the work that I do as a health care worker		I am afraid of telling my family about the risk I am exposed to		Available PPE is sufficient to protect me		Screening of patients and hospital visitors at entrance is useful	
	Adjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
Occupation								
Non-clinical (Ref.)	–	–	–	–	–	–	–	–
Nurses	0.97 (0.77–1.22)	0.78	0.97 (0.77–1.23)	0.81	0.94 (0.75–1.19)	0.61	0.99 (0.79–1.25)	0.95
Physicians	0.58 (0.40–0.86)	0.007	0.60 (0.41–0.88)	0.009	0.57 (0.39–0.83)	0.004	0.59 (0.40–0.86)	0.007
Allied health	0.90 (0.70–1.14)	0.38	0.90 (0.71–1.15)	0.40	0.89 (0.70–1.14)	0.36	0.92 (0.72–1.16)	0.48
Hypnotics for sleep								
Yes	3.42 (2.71–4.34)	<0.001	2.84 (2.85–4.52)	<0.001	3.51 (2.79–4.43)	<0.001	3.55 (2.82–4.48)	<0.001
Started/increased alcohol								
Yes	1.89 (1.55–2.30)	<0.001	1.95 (1.60–2.37)	<0.001	1.98 (1.63–2.40)	<0.001	1.94 (1.60–2.35)	<0.001
IES-R								
Disagree	1.88 (1.58–2.25)	<0.001	0.48 (0.41–0.56)	<0.001	1.84 (1.49–2.26)	<0.001	1.44 (1.16–1.80)	0.001
Age, years								
18–45 (Ref.)	–	–	–	–	–	–	–	–
46–59	0.78 (0.64–0.95)	0.01	0.78 (0.64–0.95)	0.01	0.77 (0.64–0.94)	0.008	0.76 (0.63–0.92)	0.005
60+	0.65 (0.52–0.83)	<0.001	0.68 (0.54–0.87)	0.002	0.64 (0.51–0.81)	<0.001	0.63 (0.50–0.80)	<0.001
Occupation								
Non-clinical (Ref.)	–	–	–	–	–	–	–	–
Nurses	1.12 (0.92–1.37)	0.27	1.11 (0.91–1.36)	0.32	1.10 (0.90–1.34)	0.37	1.15 (0.94–1.40)	0.16
Physicians	0.42 (0.31–0.57)	<0.001	0.44 (0.32–0.59)	<0.001	0.40 (0.30–0.54)	<0.001	0.43 (0.32–0.58)	<0.001
Allied health	0.88 (0.71–1.10)	0.22	0.89 (0.72–1.10)	0.28	0.88 (0.71–1.08)	0.21	0.91 (0.74–1.11)	0.38
Hypnotics for sleep								
Yes	4.24 (3.24–5.55)	<0.001	4.39 (3.36–5.75)	<0.001	4.29 (3.28–5.62)	<0.001	4.36 (3.34–5.69)	<0.001
Started/increased alcohol								
Yes	2.12 (1.76–2.56)	<0.001	2.14 (1.78–2.58)	<0.001	2.19 (1.82–2.63)	<0.001	2.12 (1.77–2.55)	<0.001
PHQ-9								
Disagree	1.88 (1.57–2.25)	<0.001	0.55 (0.47–0.65)	<0.001	2.10 (1.70–2.58)	<0.001	1.69 (1.35–2.11)	<0.001
Age, years								
18–45 (Ref.)	–	–	–	–	–	–	–	–
46–59	0.83 (0.67–1.02)	0.08	0.82 (0.67–1.01)	0.07	0.84 (0.68–1.03)	0.10	0.83 (0.68–1.02)	0.08
60+	0.69 (0.53–0.90)	0.007	0.69 (0.53–0.90)	0.007	0.70 (0.53–0.91)	0.007	0.68 (0.53–0.89)	0.004
Occupation								
Non-clinical (Ref.)	–	–	–	–	–	–	–	–
Nurses	0.89 (0.72–1.09)	0.26	0.89 (0.72–1.10)	0.29	0.87 (0.70–1.07)	0.18	0.90 (0.73–1.11)	0.35
Physicians	0.38 (0.27–0.54)	<0.001	0.40 (0.28–0.57)	<0.001	0.36 (0.26–0.52)	<0.001	0.39 (0.28–0.55)	<0.001
Allied health	0.78 (0.63–0.98)	0.03	0.80 (0.64–1.00)	0.05	0.79 (0.63–0.98)	0.04	0.80 (0.64–0.99)	0.04
Hypnotics for sleep								
Yes	3.84 (3.04–4.85)	<0.001	4.03 (3.20–5.09)	<0.001	3.96 (3.14–5.00)	<0.001	4.01 (3.19–5.05)	<0.001
Started/increased alcohol								
Yes	2.07 (1.72–2.49)	<0.001	2.09 (1.7–2.52)	<0.001	2.11 (1.75–2.53)	<0.001	2.07 (1.73–2.49)	<0.001

Abbreviations: CI, confidence interval; GAD-7, 7-item Generalized Anxiety Disorder scale; IES-R, 22-item Impact of Event Scale – Revised; OR, odds ratio; PHQ-9, 9-item Patient Health Questionnaire; PPE, personal protection equipment; Ref., reference.

anxiety, PTSD and depression. It is unclear whether those who communicated their perceived risk were less anxious about the risk and therefore felt able to talk about it with family or whether talking about their risk with family made them feel less distressed because their family was now aware of their risk. Another explanation may be the communication of perceived risk to family resulted in less distress because the participants now saw themselves in the role of trying to mitigate the anxiety of family members by modelling calmness.

Although family played a role in providing support for health care workers, 36.9% (n = 1367) did not talk about their perceived risk with family members. A number of factors may have played a role in this non-disclosure, including their desire to relieve their families of any concern about their own perceived risk and potential risk as well as concern that family members would respond negatively. Sharing information is a positive step towards engaging support and mitigating potential psychological distress and possible family conflict. Furthermore, while health care workers receive infection control information and education and may be provided with mental health resources by their organizations, giving their family members additional resources may be a valuable and practical intervention.

A negative perception of the protective effect of institutional infection control measures, an overall sense of a lack of support and hesitancy to discuss risk with family were all associated with use of alcohol and hypnotic medications and with a higher risk of moderate/severe symptoms of anxiety, PTSD and depression in our study. The stress of a pandemic may result in greater reliance on substances to self-medicate psychological distress and may also exacerbate previous use. Perceived social support has been found to minimize alcohol and hypnotic use, especially during stressful life events.[23-25] The intertwined relationship between support, mental health and substance use[26] should be considered in multifaceted interventions for health care workers, especially as they may engage in "escape-avoidance" behaviours to relieve distress[5,12,27]. Education and resources about healthier coping behaviours and the mental and physical effects of substance use could better assist this potentially vulnerable group.

A small percentage of those surveyed (10.9%; n = 333) were considering leaving health care, a desire that has been found to be mediated by individual experiences of occupational stress, such as workplace support, sense of efficacy and ability to complete work.[28] These are important factors that need to be addressed for worker retention. This study was performed relatively early during the COVID-19 pandemic, and emerging data about increasing departures[29] suggest that the impact of prolonged individual experiences of workplace stress will need further investigation. These aspects of workplace stress have significant implications for organizations, and system-level changes may be necessary to ensure a sense of safety, efficacy and empowerment to facilitate staff retention during and post pandemic. Support from their organizations and society has been found to help in building satisfaction and resilience among health care workers.[30] Collective support for health care workers at the beginning of the pandemic seemed universal. Support, ranging from nightly neighbourhood cheers to donated meals from local restauranteurs, served as forms of recognition that may have helped mitigate stress. Support from family and friends has also been shown to contribute to a sense of purpose and belonging with a direct impact on preventing psychological distress and fostering compliance and positive attitudes towards infection control restrictions.[19]

PPE is a safeguard for frontline staff during infectious diseases outbreaks and worries about PPE availability (often perceived to demonstrate lack of institutional support) has been a predictor of worse psychological outcomes.[4,31,32] Our study finds that trust in organizational measures is associated with degree of psychological distress, and suggests that understanding each measure's role in infection prevention and the rationale for changes to protocols in the face of emerging information on transmission is beneficial for health care workers. The ability to adhere to infection prevention and control protocols can promote a level of self-efficacy for personal safety[31], while a consistent reliable supply of PPE provides a sense of care and support on an institutional level[4,32]. Our findings demonstrate that levels of trust in the protective measures implemented by the hospital—adequate PPE, visitor screening and perceived effectiveness of alcohol hand rinse—were related to symptoms of distress. Having confidence and trust in infection control measures may result in less distress; however, trying to properly follow infection control measures may increase distress, particularly when recommendations regarding which measures are needed undergo frequent changes.

During the pandemic, information has been rapidly changing, making bidirectional communication and transparency vital.[33] A qualitative study of health care workers' experiences during the pandemic found that organizational transparency helped mitigate stress and a fear of uncertainty and to navigate changing protocols and information.[30] Effective strategies for daily communication are necessary to minimize misunderstandings that may heighten distress.[34] Strategies for receiving and integrating feedback from frontline health care workers need to be well-defined and addressed.[35] Data gaps and a lack of transparency have been found to be an ongoing issue that undermine trust in the pandemic response.[36]

Limitations

This study has several limitations. First, in order to include physicians, nurses, allied health and non-clinical health care workers, it was necessary to use a non-targeted email link, which did not allow us to estimate the response rate. Using non-targeted email links did not allow us to track the number of health care workers who saw the email and decided not to participate.

Second, several hospitals were involved in the study, and we are unable to determine possible differences in mitigating or exacerbating factors at individual organizations. In addition, we did not enquire as to whether mental health conditions or formal mental health supports existed prior to the pandemic; knowing this would have helped assess their contributions to the psychological distress that we document.

Finally, the data were collected during the first wave of the pandemic, between 14 May and 3 July 2020 for all four centres. Reporting biases, especially during a time of high stress, may have led some to complete the survey more positively and others to complete it more negatively. A follow-up survey could provide information about longer-term coping strategies and supports that the participants may have used as well as changing perceptions of and trust in infection control measures.

Conclusion

Emotional support plays a significant role in the mental health of health care workers. While formal mental health support is important, the emotional support network of family, friends and colleagues is also valuable for health care workers to rely on. These connections, especially the support of household members, play an integral role in the holistic well-being of health care workers.

Varying levels of confidence in the adequacy of infection control procedures and perception of clear communication as it relates to control strategies appears to be inversely related to levels of stress and uncertainty. In addition to information on organization-wide measures, providing insights on healthy personal coping behaviours may support worker wellness and retention, ensuring a sustainable, healthy and robust workforce.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Authors' contributions and statement

RS, LH, AM, MD, PG, ND, GL, WL and WG were involved in conceptualization of the work.

RS, LH, AM, GL and WG were involved in the funding acquisition.

RS, LH, AM, MD, JS, PG, ND, GL, PW, JN and WG conducted the investigation.

RS, LH, AM, MD, JS, PG, ND, GL, PW, WL, JN and WG curated the data.

RS, TF and VR conducted formal analysis.

RS, LH, WG and EL wrote the original draft.

All authors reviewed and edited the manuscript.

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Original quantitative research

Factors associated with high health care spending among patients with schizophrenia

Andrew J. Stewart, MSc (1); Scott B. Patten, PhD (1,2); Kirsten M. Fiest, PhD (1); Tyler S. Williamson, PhD (1); James P. Wick, MSc (2); Paul E. Ronksley, PhD (1)

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Abstract

Introduction: Understanding the reasons for the wide variation in health care spending among patients with schizophrenia may benefit the development of interventions aimed at improving patient outcomes and health care spending efficiency. The aim of our study was to determine factors associated with high health care spending in the patient population.

Methods: A serial cross-sectional study used the administrative health records of residents of Alberta, Canada between 1 January 2008 and 31 December 2017 and provincial costing methodologies to calculate total health care spending and sector-specific costs. Factors that modified the odds of being a high cost (i.e. 95th percentile or higher) patient with schizophrenia were estimated using generalized estimating equations.

Results: This study captured 242 818 person-years of observations among 38 177 unique patients with schizophrenia. Increased odds of being a high-cost patient were associated with younger age (18–29 years), male sex, unstable housing status and requiring care from multiple medical specialties. The strongest estimated associations between high cost status and comorbidity were for metastatic cancer (OR = 2.26) and cirrhosis (OR = 2.07). In contrast, polypharmacy was associated with a decreased odds of being high cost compared with untreated patients.

Conclusion: Factors associated with being a high-cost patient are the result of complex interactions between individual, structural and treatment-related factors. Efforts to improve patient outcomes and address rising health care costs must consider the value of allocating resources towards early detection and support of patients with schizophrenia along with the prevention/management of comorbidity.

Keywords: *schizophrenia, health services research, comorbidity, health care expenditures*

Highlights

- Younger patients with schizophrenia (18–29 years old) were more likely than older patients to be high cost.
- Of the 29 comorbidities assessed, 17 were associated with an increased odds of being a high-cost patient.
- Increasing involvement of medical specialties increases the odds of being a high-cost patient.
- The odds of being a high-cost patient if unstably housed are 2.49 times greater than if stably housed. This suggests that the risk factors driving cost extend beyond clinical or demographic domains.

Introduction

Population-based studies have shown that a small proportion of patients use the majority of health care resources,[1-5] and about 5% of the patient population use 65% of the health resources.[2,6] The clinical and demographic characteristics of these “high-needs/high-cost” patients vary substantially,[7] and the presence of underlying mental health conditions has been identified as a key driver of health care use and subsequent spending.[8,9]

Schizophrenia is a mental health condition known for its association with high levels of disability and health care utilization.[10-12] The economic costs of providing mental health services varies widely between patients.[13] The published literature has linked several factors to increased health spending, including age, sex, number of social contacts, length and frequency of hospitalizations, socioeconomic status, access to community supports, and pharmaceutical management strategies.[13-18] Increasing multimorbidity among patients with schizophrenia is expected to further expand health care need and resource use by this population.[19]

The literature describing the characteristics of high-cost patients with schizophrenia continues to grow as the management of this condition evolves. Inpatient costs have long been the largest proportion of direct health-care spending for patients with schizophrenia.[11] This is changing with prescription costs for second-generation antipsychotic medications outpacing hospital spending for the first time.[19] Patients with schizophrenia are living longer, and their treatment is increasingly

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Author references:

1. Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, Canada
2. Department of Medicine, Cumming School of Medicine, University of Calgary, Calgary, Canada

Correspondence: Paul E. Ronksley, Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Cal Wenzel Precision Health Building, 3280 Hospital Drive NW, Calgary, AB T2N 4Z6; Tel: 403-220-8820; Email: peronksl@ucalgary.ca

complex as additional chronic conditions develop.[19] Finally, there remains a need for large studies that characterize the entire spectrum of this patient population.

As the cost of delivering health care in North America continues to increase, it is important to record changing demographic and spending patterns so that discussions on spending efficiency remain relevant. Improving our knowledge of the clinical and sociodemographic factors driving health care spending in this patient population is necessary to determine areas of patient management with the greatest potential effects on health outcomes and quality of life. With this in mind, we conducted a population-based study using administrative health data from the Canadian province of Alberta to determine factors associated with high-cost status among patients with schizophrenia.

Methods

Data sources

We conducted a serial cross-sectional study using administrative and clinical data from the province of Alberta, Canada, collected between 1 January 2008 and 31 December 2017 (i.e. ten 1-year cross-sections). This included information on hospitalizations (Discharge Abstract Database), emergency department visits (National Ambulatory Care Reporting System), practitioner billings, the Pharmaceutical Information Network (to collect outpatient prescription information), the population health registry file, and Alberta Vital Statistics (for date of death information) maintained by Alberta's Ministry of Health. The choice of datasets used was informed by work previously completed by our research group.[20]

Study population

We identified patients with schizophrenia aged 18 years and older using a validated case-ascertainment algorithm. The presence of schizophrenia was defined as "1 hospitalization or 2 physician billing claims in 2 years or less associated with a F20.X, F21.X, F23.2 or F25.X International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) code or a '295.X' ICD-9 code."[21-23] This algorithm has a reported positive predictive value of 87% and a sensitivity of 87%.[21] Patients with schizophrenia entered the cohort on the date of their first schizophrenia-specific ICD code and were followed until death, outmigration from the Alberta health system or the end-of-study follow-up (31 December 2017).

Calculating costs

Average cost per patient was estimated for each calendar year from 2008 to 2017. Micro-costing information was not available at the provincial level, so we estimated costs for hospitalizations and emergency department visits using Resource Intensity Weights (RIWs) for each encounter multiplied by the average cost in Alberta of a "typical" encounter. The Canadian Institutes for Health Information (CIHI) calculates annual RIWs by using ICD-10 most responsible diagnosis codes to define case-mix groups from samples of patients.[24] Resource utilization by these groups is measured and used to determine the average resource utilization for a full course of treatment from admission to discharge for a "typical" case. This value is then weighted to adjust for increased resource utilization associated with additional comorbidity and medical complications. RIW estimates have been found to correlate well with the gold standard of micro-costing.[25]

Outpatient physician visits were costed according to the Alberta Health Schedule of Medical Benefits. Medication costs were estimated by multiplying the Alberta Drug Benefit List cost for dispensed medication by the quantity dispensed.

This costing analysis focussed on direct health-care spending only. Direct nonmedical costs (e.g. transportation and accommodations required to attend medical appointments, informal care provided by unpaid caregivers, formal care provided by professional caregivers, etc.) and indirect nonmedical costs (e.g. incurred by absenteeism from work, forced retirement due to illness, etc.) could not be obtained from the data sources used.

To facilitate comparison with existing literature, a high-cost patient with schizophrenia was defined as one with annual direct health-care costs in the 95th percentile or greater. This was determined independently for each fiscal year between 2008 and 2017.[1,6,9,26]

Gelberg-Andersen Behavioral Model for Vulnerable Populations

Risk factors for high cost status considered in this work were informed by the Gelberg-Andersen Behavioral Model for Vulnerable Populations.[27] This model uses a holistic approach when describing factors associated with health care utilization.[27] It includes three domains with special attention to vulnerable exposures: environmental factors (e.g. geography, social environment); population characteristics (e.g. predisposing, enabling and need factors); and health behaviours (e.g. seeking specialist care, other patterns of health care access).[27] Variables available in the provincial administrative data sources were mapped to these domains (see Table 1).

Patient and prescription information

We extracted the demographic and clinical characteristics of all patients from the same administrative datasets. These included age, sex and postal code (to derive urban/rural status). We used census data and postal codes to capture material and social deprivation indices as proxies for socioeconomic status.[28]

Comorbidity profiles were determined using 29 case-ascertainment algorithms defined by Tonelli et al.[21] A proxy measure for housing stability was generated by searching health care records for a record of homelessness (Z59 ICD-10 code) or a shelter-associated postal code.

Finally, annual prescription information (Anatomical Therapeutic Chemical [ATC] and date of prescription) was obtained for each patient through Alberta's Pharmaceutical Information Network. We used this information to determine the number of unique pharmaceuticals prescribed to each patient per calendar year. We defined polypharmacy as the prescription of 5 to 9 unique medications and extreme polypharmacy as the prescription of 10 or more unique medications in a single year. This definition is the one used most frequently in the literature.[29]

We used the Drug Identification Number (DIN) of each prescribed antipsychotic medication to determine whether they were administered orally or via injection. Physician claims codes were used to determine the medical specialty associated with care. We generated a proxy measure of treatment for comorbidity by counting the number of unique specialities seen during the study period, that is, beyond care received from general practitioners and psychiatrists.

TABLE 1
Variables available for the modelling of direct costs mapped to the Gelberg-Andersen Behavioral Model for Vulnerable Populations

Environment	Population characteristics			Health behaviour
	Predisposing characteristics	Enabling resources	Need	
Single-payer health care system[a]	• Age • Sex • Material and social deprivation (socioeconomic status) • Comorbidities	• Urban/rural residence • Primary care attachment • Housing stability	• Comorbidities • Duration of illness • Treatment exposure • Polypharmacy exposure	• Specialist care encounters • Psychiatrist encounters • General practitioner encounters

Source: Gelberg L, et al.[27]

[a] Constant for all patients.

Models and analysis

Patient demographic and clinical characteristics were summarized using means and standard deviations, medians and interquartile ranges, or proportions as appropriate. The outcome of interest for this work was the odds of being a high-cost patient.

We built models using generalized estimating equations because they provide estimates of population-averaged effects and have been found to offer robust estimates even in cases where uncertainty surrounds covariance structures.[30] The odds of being a high-cost patient were linked to exposure variables using a logit link. An unstructured covariance matrix was specified given the large number of observations available and the potential for improved model fit by limiting assumptions to do with the covariance structure of relationships.

We developed univariate regression models for each factor and subsequently created a correlation matrix to assess collinearity. After determining an absence of strong correlations between variables, we ran a series of models to estimate associations between exposures and the odds of being a high-cost patient. Models were generated iteratively using a forward building approach to ensure convergence could be attained. To generate the most parsimonious model, we excluded comorbidities associated with a p-value greater than or equal to 0.05. A sensitivity analysis allowed us to understand the implications of choosing different cut-points for high cost (i.e. 90th and 99th percentiles of health care spending).

All analyses were completed using Stata version 16 (StataCorp LLC, College Station, TX, US).[31] This study follows the REporting of studies Conducted using Observational Routinely-collected Data (RECORD) statement.[32] The University of Calgary Conjoint Health Research Ethics Board approved this study and granted waiver of patient consent (REB16-1575).

Results

This study captured 242 818 person-years of observations from 38 177 unique adult patients with schizophrenia in the 10-year study time frame. Males contributed 138285 person-years of observations and females contributed 104 533 (see Table 2). Of the 38 177 unique patients, 2463 were defined as high cost based on the 95% percentile of health spending (12 146 person-years).

Adjusting for inflation, the 95% percentile cut-off for cost ranged from $62 998 to $74 906 (2017 CAD) over the 10-year period, and the top 5% of patients accounted for between 47.4% and 54.9% of total spending in the cohort in a given year (data not shown).

Person-years of exposure were not distributed equally between high-cost and non-high-cost patients. For example, high-cost patients contributed 16.4% of person-years spent as unstably housed. Older patients also contributed a higher proportion of observations to the high cost group. All 29 comorbidities assessed were over-represented in the high cost group (see Table 2).

Most factors identified in the Gelberg-Andersen Behavioral Model for Vulnerable Populations[27] were found to be significant in our univariate analysis. Notable exceptions were an individual's rural/urban status, and the number of visits to general practitioners and psychiatrists (data available on request from the authors).

Several trends emerged in the multivariable analysis (see Figure 1). The estimated odds of being high cost were highest for patients aged 18–29 years (OR = 1.63, 95% CI: 1.51–1.77, $p < 0.01$) compared to those aged 40–49 years. Female patients with schizophrenia had lower odds of being high cost than male patients (OR = 0.87, 95% CI: 0.83–0.92, $p < 0.01$). The odds of being a high-cost patient if unstably housed were 2.49 times greater than if stably housed (95% CI: 2.34–2.65, $p < 0.01$).

Increasing numbers of prescribed medications were associated with decreased odds of being high cost. Patients classified as having extreme polypharmacy (10 or more unique prescribed medications) were about 0.62 times less likely to be high cost than patients who did not receive prescription drugs (95% CI: 0.58–0.67, $p < 0.01$). Patients receiving both injectable and oral antipsychotic formulations were associated with the highest estimated odds of being high cost (OR = 4.97, 95% CI: 3.66–6.75, $p < 0.01$).

In the regression model, the greatest difference in odds of being high cost was observed among patients who received care from three or more medical specialties compared with those who had not received specialist care (excluding general practitioners and psychiatrists). Estimated odds ratio was 14.70 (95% CI: 13.31–16.23, $p < 0.01$). Increasing involvement of medical specialties resulted in increasing odds of being a high-cost patient (see Figure 1).

Of the comorbidities assessed, the highest odds of being a high-cost patient (relative to those without the comorbidity of interest) were associated with metastatic cancer (OR = 2.26, 95% CI: 1.97–2.60, $p < 0.01$), cirrhosis (OR = 2.07, 95% CI: 1.73–2.48, $p < 0.01$) and lymphoma (OR = 1.86, 95% CI: 1.48–2.35, $p < 0.01$).

TABLE 2
Comparison of high versus non-high cost of adult (≥18 years) patients with schizophrenia by clinical and demographic characteristic

Characteristics	Person-years, n (%)		Total person-years, n (% of cohort person-years)
	High cost	Non-high cost	
Age ranges in years			
18–29	2404 (5.6)	40 246 (94.4)	42 650 (17.6)
30–39	1905 (4.0)	45 358 (96.0)	47 263 (19.5)
40–49	1844 (3.8)	46 869 (96.2)	48 713 (20.1)
50–59	2388 (4.6)	48 997 (95.4)	51 385 (21.2)
60–69	1818 (6.1)	27 939 (93.9)	29 757 (12.3)
70–79	1103 (8.0)	12 713 (92.0)	13 816 (5.7)
80+	672 (7.5)	8341 (92.5)	9013 (3.7)
Sex			
Male	6613 (5.0)	131 672 (95.0)	138 285 (57.0)
Female	5533 (5.3)	99 000 (94.7)	104 533 (43.1)
Housing stability			
Unstably housed	2220 (16.4)	11 291 (83.6)	13 511 (5.6)
Stably housed	9926 (4.3)	219 381 (95.7)	229 307 (94.4)
Missing social deprivation (no address)	1408 (6.3)	20 960 (93.7)	22 368 (10.1)
Deprivation index			
1st quartile (least deprived)	867 (4.4)	19 910 (95.6)	20 777 (9.4)
2nd quartile	739 (4.1)	17 157 (95.9)	17 896 (8.1)
3rd quartile	1235 (4.3)	27 478 (95.7)	28 713 (13.0)
4th quartile	2324 (5.0)	44 504 (95.0)	46 828 (21.2)
5th quartile (most deprived)	4328 (5.1)	79 716 (94.9)	84 044 (38.1)
Years since diagnosis			
0–2 (1st quintile)	3873 (6.0)	60 467 (94.0)	64 340 (26.5)
3–5 (2nd quintile)	1919 (4.2)	43 534 (95.8)	45 453 (18.7)
6–9 (3rd quintile)	1753 (4.3)	39 477 (95.7)	41 230 (17.0)
10–15 (4th quintile)	2261 (4.7)	45 962 (95.3)	48 223 (19.9)
16–23 (5th quintile)	2340 (5.4)	41 232 (94.6)	43 572 (17.9)
Number of specialists seen[a]			
0 (none)	603 (0.6)	93 945 (99.4)	94 548 (38.9)
1	1547 (3.1)	49 159 (96.9)	50 706 (20.9)
2	2135 (5.4)	37 411 (94.6)	39 546 (16.3)
≥3	2340 (4.0)	41 232 (96.0)	58 018 (23.9)
Access to generalist and psychiatric care			
No GP or psychiatrist	13 (0.8)	1644 (99.2)	1657 (0.7)
GP only	866 (1.0)	83 561 (99.0)	84 427 (34.8)
Psychiatrist only	88 (0.6)	14 057 (99.4)	14 145 (5.8)
Both GP and psychiatrist	11 179 (7.8)	131 410 (92.2)	142 589 (58.7)
No. of drugs prescribed			
0	1498 (3.8)	38 436 (96.2)	39 934 (16.5)
1–2	907 (2.7)	32 543 (97.3)	33 450 (13.8)
3–5 (polypharmacy)	1641 (3.3)	48 626 (96.7)	50 267 (20.7)
≥6 (extreme polypharmacy)	8100 (6.8)	111 067 (93.2)	119 167 (49.1)
Antipsychotic prescription			
None	6178 (3.9)	153 126 (96.1)	159 304 (65.6)
Oral antipsychotic	5837 (7.0)	77 008 (93.0)	82 845 (34.1)
Injectable antipsychotic	40 (16.8)	198 (83.2)	238 (0.1)
Oral + injectable antipsychotic	91 (26.8)	340 (73.2)	431 (0.2)

Continued on the following page

TABLE 2 (continued)
Comparison of high versus non-high cost of adult (≥18 years) patients with schizophrenia by clinical and demographic characteristic

Characteristics	Person-years, n (%)		Total person-years, n (% of cohort person-years)
	High cost	Non-high cost	
Comorbidities			
Alcohol misuse	4893 (8.4)	58 302 (91.6)	63 195 (26.0)
Asthma	1658 (8.6)	17 279 (91.4)	18 937 (7.8)
Atrial fibrillation	878 (12.0)	6418 (88.0)	7296 (3.0)
Cancer, lymphoma	139 (16.0)	732 (84.0)	871 (0.4)
Cancer, metastatic	377 (17.5)	1783 (82.5)	2160 (0.9)
Cancer, non-metastatic	582 (10.9)	4771 (89.1)	5353 (2.2)
Chronic heart failure	1570 (12.8)	10 722 (87.2)	12 292 (5.1)
Chronic kidney disease	4612 (6.8)	62 744 (93.2)	67 356 (27.7)
Chronic pain	2912 (7.8)	34 566 (92.2)	37 478 (15.4)
Chronic pulmonary disease	3595 (8.3)	39 735 (91.7)	43 330 (17.8)
Chronic viral hepatitis B	48 (6.6)	679 (93.4)	727 (0.3)
Cirrhosis	231 (21.1)	862 (78.9)	1093 (0.5)
Dementia	3523 (10.9)	28 774 (89.1)	32 297 (13.3)
Depression	9745 (8.4)	106 090 (91.6)	115 835 (47.7)
Diabetes	3336 (7.6)	40 637 (92.4)	43 973 (18.1)
Epilepsy	1599 (7.9)	18 601 (92.1)	20 200 (8.3)
Hypertension	5349 (7.4)	66551 (92.6)	71900 (29.6)
Hypothyroidism	2354 (7.4)	29 461 (92.6)	31 815 (13.1)
Inflammatory bowel disease	250 (7.7)	2977 (92.3)	3227 (1.3)
Irritable bowel syndrome	727 (8.0)	8323 (92.0)	9050 (3.7)
Multiple sclerosis	312 (10.1)	2762 (89.9)	3074 (1.3)
Myocardial infarction	285 (8.5)	3074 (91.5)	3359 (1.4)
Parkinson disease	1028 (10.0)	9300 (90.0)	10 328 (4.3)
Peptic ulcer disease	183 (23.6)	592 (76.4)	775 (0.3)
Peripheral vascular disease	258 (10.0)	2310 (90.0)	2568 (1.1)
Psoriasis	210 (6.7)	2907 (93.3)	3117 (1.3)
Stroke	1813 (9.8)	16 742 (90.2)	18 555 (7.6)
Rheumatoid arthritis	457 (9.5)	4377 (90.5)	4834 (2.0)
Severe constipation	1287 (15.8)	6879 (84.2)	8166 (3.4)

Abbreviation: GP, general practitioner.

[a] This excludes general practitioners and psychiatrists.

However, other mental health disorders also ranked high among comorbidities. Depression was associated with an odds ratio of 2.63 (95% CI: 2.50–2.78, $p < 0.01$) and dementia with an odds ratio of 2.04 (95% CI: 1.92–2.17, $p < 0.01$).

Sensitivity analyses using the 90th and 99th percentile for "high cost" produced similar results (available from the authors on request).

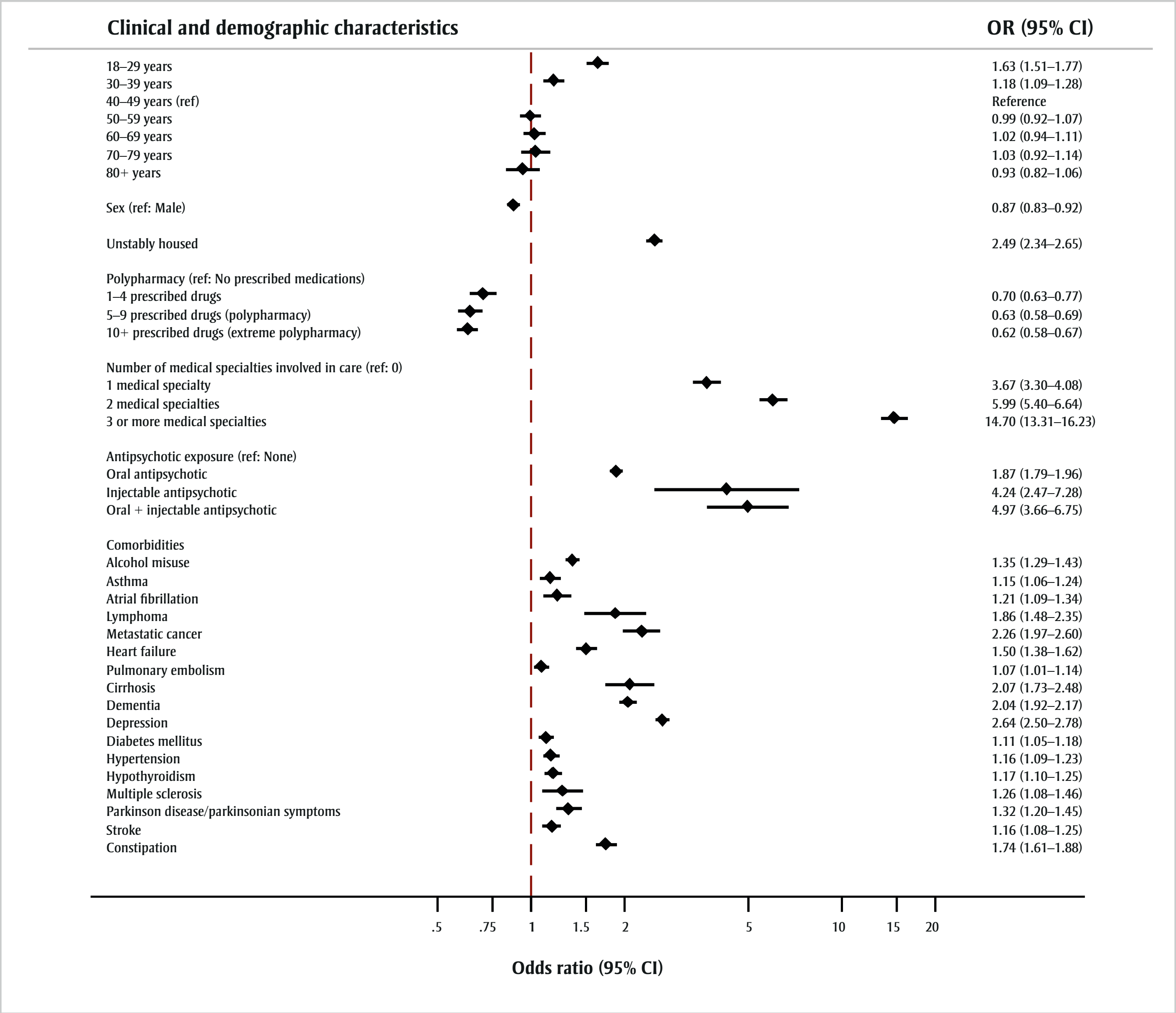
Discussion

Using 10 years of administrative health data collected from patients with schizophrenia in Alberta, Canada, we identified several notable associations between the odds of being a high-cost patient and a patient's demographic characteristics, their underlying medical complexity and the care they received. Many of these factors are policy relevant and require discussion on the ways current management strategies can be adapted to improve health outcomes while addressing health system sustainability.

We found that younger patients with schizophrenia (aged 18–29 years) were more likely to be high cost. The high level of health care need among younger, newly diagnosed patients with schizophrenia is well established. Nicholl et al.[33] observed a considerably higher economic burden in the year following treatment for a first psychotic episode than for chronic patients. Similarly, Jin et al.[34] reported that, compared to older patients, younger patients with schizophrenia had higher rates of service use for five of six service categories assessed (i.e. inpatient, emergency room, crisis house, outpatient and day treatment).

Early detection of schizophrenia, giving patients and clinicians more time to stave off severe outcomes associated with the development of psychosis, could address this association with age. Schizophrenia is often first identified in early adulthood with the onset of psychosis.[12] A series of risk factors detectable at birth or during childhood allow for the identification of at-risk children. These factors include a family history of schizophrenia, the presence of 22q11.2 deletion syndrome (or several other copy number variants) and

FIGURE 1
Conditional associations for high cost status among adult (≥18 years) patients with schizophrenia



Abbreviations: CI, confidence interval; OR, odds ratio; ref, reference.

the childhood manifestation of transient psychotic symptoms.[35] Sommer et al.[35] suggested that health care efficiencies could be realized by applying targeted interventions to children with these risk factors. Promising interventions include those that work to address suboptimal maturation of neuronal pathways during childhood (e.g. treatment with neurotransmitter antagonists and dietary supplementation), the reduction of environmental insults during childhood through the use of social skills training and early interventions to prevent drug use, and the improvement of resilience through cognitive remediation and exercise training.[35]

The association between age and high cost status reinforces the value of the early detection of schizophrenia. First episode/early psychosis programs exist in Alberta, and our finding suggests that patients may benefit from expanding these programs.

The early onset of schizophrenia has far-reaching consequences as the development of symptoms often occurs during critical years. Schizophrenia often impacts a patient's level of education attainment, career development and personal relationships.[12] As a result, homelessness is common among patients. This is of concern as a patient's living situation impacts their ability to access treatment and health care supports. Our work identified a strong association between being unstably housed (our proxy measure for homelessness) and being a high-cost patient.

We previously identified that new antipsychotic formulations may be associated with reduced hospitalization costs.[19] However, these treatments cannot help an individual who is unable to access them consistently. While this work focusses on direct health-care costs, investment in supportive housing initiatives such as "Housing First" policies that aim to move mental health patients into stable housing as rapidly as possible may represent an important avenue for improving outcomes and health care spending efficiency. In a Canadian pilot study, At Home/Chez Soi participants randomized to receive a Housing First intervention were able to attain stable housing much more rapidly than the treatment-as-usual control group.[36] This has important implications for patients with schizophrenia who are experiencing homelessness, and we believe that early access to this type of support for younger patients may markedly change disease trajectories and quality of life. Furthermore, housing price to income ratios continue to climb and low-income, older and single Canadians are increasingly being priced out of the housing market.[37] Efforts must be made to prevent patients with schizophrenia from being left behind.

Patients with schizophrenia are highly reliant on the pharmaceutical management of symptoms. Contrary to our assumptions, we found a negative association between the odds of being high cost and the number of prescribed medications, with the greatest reduction in odds for those with extreme polypharmacy (10 or more unique medications prescribed in a single year). The reduction in odds for those with polypharmacy may be a function of improved management of comorbidity as well as a more active approach in finding efficacious antipsychotic treatment options while minimizing treatment side effects. Alternatively, different polypharmacy profiles may be differentially associated with the odds of being a high-cost patient. Given this uncertainty, further exploration of this trend is necessary.

Underlying comorbidity is also an important factor to consider when discussing high medical costs. Of the 29 comorbidities assessed, 17 were associated with an increased odds of being a high-cost patient. We observed that neurological and mental health conditions such as dementia and depression were highly associated with high cost status. Co-occurring medical conditions are often overlooked during the treatment of patients with schizophrenia.[38] The strength of these associations highlights the fact that a diagnosis of schizophrenia should not overshadow patient need for the management and prevention of the many comorbid conditions in this population. Like many medical conditions, improving care coordination and connections between medical specialties may pay dividends in the improvement of patient outcomes and result in reductions in total patient spending.

While consideration of single morbidities helps improve our understanding of the conditions that contribute to high health care spending, it does not provide a complete picture. Multimorbidity among patients with schizophrenia is common, with some studies estimating that it occurs 2 to 3 times more often than in the general population.[39] Although we did not assess multimorbidity directly in our models, we did include information on the number of different medical specialities involved in a patient's care. Increasing numbers of medical specialties have the strongest association with the odds of being high cost. It may be that level of specialist involvement is a proxy for the level of medical complexity in this population. This would suggest that interventions aimed at addressing medical complexity of patients would result in increases in health care efficiency.

While not specific to schizophrenia, the Lancet Psychiatry Commission on protecting the physical health of people living with mental illness has developed a comprehensive blueprint of interventions for individuals at-risk for developing mental illness, patients undergoing their initial treatment and those undergoing continuing care.[40] Reductions in medical complexity may be realized by improving the integration between physical and mental health care, training interventions for the reduction of diagnostic overshadowing, and further investigating the attenuation of the long-term effects of antipsychotic medications.[40]

Strengths and limitations

A strength of this study is the use of population-based administrative data that allow for a comprehensive evaluation of the subset of patients with schizophrenia who incur high direct health-care costs. We were able to capture 12 146 person-years of exposures from 2463 patients who were deemed high cost over a 10-year period. This information allowed us to estimate a diverse set of individual, systemic and treatment-associated variables related to health care use and spending.

The use of administrative data for this investigation does have some unavoidable limitations. First, as data were not collected specifically for this investigation, we used several proxy variables. For example, an algorithm for identifying homelessness in administrative data was recently developed in Ontario.[41] This algorithm relies on data from the Ontario Mental Health Reporting System (OMHRS) that includes detailed information on the use of mental health services not available in Alberta. As a result, we used an adapted algorithm that we believe has high specificity but that may nevertheless underestimate the association between homelessness and high cost status.

Second, community and indirect costs associated with schizophrenia (absenteeism, sick leave, decreased work productivity among patients and caregivers, unemployment, permanent disability and lost productivity due to premature death) were not available in these datasets. With indirect costs associated with schizophrenia estimated as contributing between 50% and 85% of total costs,[42] the lack of this information limited our ability to quantify the total cost attributable to schizophrenia or the potential role community support programs play on the trends observed.

Despite this, we believe that our description of the association between the various patient- and care-related factors and the odds of being a high-cost patient with schizophrenia captures important dynamics that can help inform evidence-based approaches to improving patient outcomes and cost-savings.

Our findings may not be generalizable to other countries given Canada's single-payer health care system, but they appear generalizable to other Canadian provinces. For example, de Oliveira et al.[8] found a similar association between high cost status and age among patients with schizophrenia in Ontario, and Rais et al.[43] reported a similar cost distribution between high-cost patients and the general population in Ontario.

Finally, our work addresses an important gap by analyzing data that do not depend on sample selection pressures associated with clinics and is therefore more representative of the true patient population that access health services.

Conclusion

The evidence presented here suggests that individual, structural and treatment-related factors all play a role in determining high health spending among patients with schizophrenia. This work confirms several relationships reported in the literature and highlights that underlying medical complexity and subsequent management of multimorbidity play important roles in the subset of patients that drive health care spending. We hope these findings spark further investigation, and inform policy discussions on resource allocation and continued efforts to curb health spending while improving care for patients with schizophrenia.

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Conflicts of interest

None.

Authors' contributions and statement

Conceptualization – AS, PR and SP. Methodology – AS, PR and SP. Software – AS and JW. Validation – JW. Formal Analysis – AS and PR. Investigator – AS. Resources – PR. Data Curator – JW. Writing – Original Draft: AS. Writing – Review and Editing – AS, PR, SP, TW and KF. Visualization – AS. Supervision – PR and SP. Project Administration – AS. Funding Acquisition – PR.

The interpretation and conclusions are those of the researchers and do not represent the views of the Government of Alberta. Neither the Government of Alberta nor Alberta Health express any opinion in relation to this study.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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Commentary

Clinical public health: harnessing the best of both worlds in sickness and in health

Bernard C. K. Choi, PhD (1,2,3); Arlene S. King, MD, MHSc (1); Kathryn Graham, PhD (1,4); Rose Bilotta, MD, MHSc (1); Peter Selby, MBBS, MHSc (1,4,5,6); Bart J. Harvey, MD, PhD (1); Neeru Gupta, MD, PhD (1,7,8); Shaun K. Morris, MD, MPH (1,9,10); Eric Young, MD, MHSc (1,3); Pierrette Buklis, MHSc, RD (1); Donna L. Reynolds, MD, MSc (1,5); Beth Rachlis, PhD (1,11); Ross Upshur, MD, MSc, MA (1,5,12)

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Abstract

Introduction: Effective, sustained collaboration between clinical and public health professionals can lead to improved individual and population health. The concept of clinical public health promotes collaboration between clinical medicine and public health to address complex, real-world health challenges.

In this commentary, we describe the concept of clinical public health, the types of complex problems that require collaboration between individual and population health, and the barriers towards and applications of clinical public health that have become evident during the COVID-19 pandemic.

Rationale: The focus of clinical medicine on the health of individuals and the aims of public health to promote and protect the health of populations are complementary. Interdisciplinary collaborations at both levels of health interventions are needed to address complex health problems. However, there is a need to address the disciplinary, cultural and financial barriers to achieving greater and sustained collaboration. Recent successes, particularly during the COVID-19 pandemic, provide a model for such collaboration between clinicians and public health practitioners.

Conclusion: A public health approach that fosters ongoing collaboration between clinical and public health professionals in the face of complex health threats will have greater impact than the sum of the parts.

Keywords: *clinical medicine, public health, multidisciplinary collaboration, sickness, health, population health, wicked problem, megatrend, syndemic*

Introduction

Clinical medicine and public health are regarded as distinct disciplines that focus on individual and population health, respectively. Complex health challenges such as those recently posed by the COVID-19 pandemic highlight the importance of more effective and sustained collaboration between the two disciplines to reduce morbidity and mortality and ensure timely research, practice and policy initiatives.

Our previous empirical study indicates that stronger links between clinical medicine and public health can lead to novel research and training opportunities.[1] The study provides the necessary framing for sustained collaboration and coordination between the two disciplines.[1] Our paper also describes the origin and brief history of the term “clinical public health.”[1]

For the purpose of this commentary, we define clinical public health as the structured and systematic collaboration of clinical and public health professionals in pursuit of common health goals. We argue that adopting, promoting and formalizing the concept of clinical public health can facilitate the necessary interdisciplinary collaboration to improve health for all.

Public health and clinical health professionals already work together to optimize individual and population health in areas such as health promotion and disease surveillance, prevention and control. In the context of the COVID-19 pandemic, examples

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Author references:

1. Division of Clinical Public Health, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada
2. Public Health Agency of Canada, Ottawa, Ontario, Canada
3. School of Epidemiology and Public Health, University of Ottawa, Ottawa, Ontario, Canada
4. Centre for Addiction and Mental Health, Toronto/London, Ontario, Canada
5. Department of Family and Community Medicine, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada
6. Department of Psychiatry, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada
7. Department of Ophthalmology and Vision Sciences, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada
8. Keenan Research Centre for Biomedical Science, St. Michael’s Hospital, Unity Health Toronto, Ontario, Canada
9. Department of Pediatrics, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada
10. Division of Infectious Diseases, Hospital for Sick Children, Toronto, Ontario, Canada
11. ICES, Toronto, Ontario, Canada
12. Lunenfeld Tanenbaum Research Institute, Sinai Health System, Toronto, Ontario, Canada

Correspondence: Bernard C. K. Choi, Public Health Agency of Canada, 785 Carling Avenue, PL# 6806A, Ottawa, ON K1A 0K9; Email: bernard.choi@phac-aspc.gc.ca
Ross Upshur, Division of Clinical Public Health, Dalla Lana School of Public Health, University of Toronto, 678-155 College Street, Toronto, ON M5T 3M7; Email: ross.upshur@gmail.com

have included the development of testing strategies and mathematical projections of cases, hospitalizations and deaths that affect both population health, and access to clinical and hospital services. There have been calls to improve collaboration between primary care and public health, with some success;[2-3] however, these efforts are still in the preliminary stages. As exemplified by the COVID-19 pandemic, complex clinical and public health challenges require solutions beyond the scope of either clinical medicine or public health alone.

Clinical medicine and public health are sister sciences

In Greek mythology, curative medicine and health promotion were two separate but closely related fields of medicine.[4] Panacea (the goddess of treatment) and Hygiea (the goddess of prevention and wellness) were daughters of Asklepios (the god of medicine).[4] In 1938, Paul suggested that curative medicine and preventive medicine are "sister sciences," with both committed to the same therapeutic program.[5]

Despite the central distinction that the patient in clinical medicine is an individual and that the patient/client in public health is an entire population, there are similarities in the core functions[6,7] of these sister sciences (see Table 1). The similar nature of these core functions provides a foundation for collaboration in the combined enterprise of clinical public health.

Rationale for clinical public health

Complex health challenges include wicked problems, megatrends and syndemics. Wicked problems have no definitive formulation, no stopping rule, no test of a solution and no enumerable set of solutions. They do not allow learning by trial-and-error. They are unique, are symptoms of other problems, can be explained in numerous ways, are not true-or-false and have immense consequences.[8] Examples include climate change and the obesity epidemic.[9]

Megatrends are large changes that are slow to form (often developing over decades), but once formed, have widescale impacts that are difficult if not impossible to reverse.[10-12] An example is the social and physical effects of ubiquitous connectivity.

Syndemics, or synergistic epidemics, involve two or more diseases (e.g. infectious, chronic) that worsen the prognosis for each and are compounded by enhanced vulnerability to negative determinants of health.[13] An example is the SAVA syndemic (substance abuse, violence and HIV/AIDS).[14]

The COVID-19 pandemic is a prime example of a wicked problem with serious health, social and economic consequences. It also emerges as a megatrend with broad health impacts[15] that can spiral out of control over time, causing insidious and far-reaching effects of "long COVID" on individuals, families and the health care system.[16] The coexistence and interactions of COVID-19 with chronic disease and social and economic inequality also make it a syndemic.[17,18]

The salience of the COVID-19 pandemic has led to sustained collaboration between clinical and public health professionals that has not always occurred in response to other health issues. This suggests that formally recognizing this collaboration, and advancing coordination of activities that share common aims under the concept of clinical public health, can facilitate meaningful solutions to other real-world complex health problems through joint approaches to policy development, education, research, health services and training of clinical and public health professionals.

TABLE 1
Comparison of the core functions of clinical medicine and of public health

Core functions of clinical medicine[6]	Core functions of public health[7]
Assess individual health status	Population health assessment
Distinguish between the ill and the well	Health surveillance
Care for the ill, including helping individual people cope with illness	Health protection
Cure illness, where possible	Health promotion
Prevent illness	Disease and injury prevention
(Implied: Emergency care for the acutely ill, or emergency medicine)[a]	Emergency preparedness and response

[a] Although clinical medicine has "emergency medicine," it is not listed in Childs[6].

Achieving the vision of clinical public health

Clinical and public health professionals need to overcome ideological and structural barriers to collaboration. For example, the clinical focus on the doctor–patient relationship may limit consideration of public health goals and functions. On the other hand, the public health focus on improving the health of populations may lead to underestimating the importance of clinical preventive interventions at the individual level.

Promoting mutual understanding of the work and science of clinical and public health professionals is fundamental to a collaborative approach whereby practitioners can maximize effectiveness by fitting the intervention level to the nature of the problem.

Below are examples of efforts required to achieve multilevel coordination for population and individual health.

Enhancing the role of clinical practitioners in public health research

One strategy for achieving greater collaboration would be to provide joint training and research opportunities for clinical and public health practitioners. Furthermore, many clinical practitioners and public health physicians have unpaid, adjunct appointments in their respective academic departments. This can limit greater collaboration, as faculty who are engaged in the practice of medicine or public health often feel of lesser status than "core" tenured faculty.

There is also the issue of time. Adjunct professors often have positions of responsibility and feel squeezed between their paid work and their desire to contribute to research and education. Some universities are now hiring salaried clinical professors, also known as professors of practice.[19] This arrangement could be extended to professors in other fields such as clinical public health.

Addressing discipline barriers

There are important benefits to integrating the individual patient-level and population-level perspectives of the primary care and public health sectors.[20] Clinical medicine focusses on disease diagnosis and treatment, but because clinicians are often the first point of contact with health services, they provide opportunities for primary and secondary disease prevention. However, there are barriers related to discipline training and procedures. Clinicians may not be able to offer preventive services to their patients, because of lack of reimbursement, lack of time or patient refusal, among other reasons.[21]

Addressing barriers related to funding practices

Health funding has separate budgets for individual health (curative care, rehabilitative care, long-term care, ancillary services and medical goods) and population health (prevention and public health services, health administration and insurance).[22] This can create barriers to greater collaboration. In addition, chronic underfunding and deepening cuts to public health budgets, particularly at municipal levels, challenge clinical medicine–public health collaboration.[23] Considered the "poor cousin of clinical medicine,"[24] public health is typically allocated only a small proportion of the total annual health budget.[25]

Clarifying roles

Confusion over the role and mandate of clinical medicine (individual-based) versus public health (population-based) may prevent effective clinical public health. For instance, in some jurisdictions public health plans the delivery of immunization services and provides the clinical service of administering immunizations. In other jurisdictions, immunizations are administered almost exclusively by clinicians.

Collaboration under the banner of clinical public health might help clarify roles, reduce confusion and improve efficiencies.

Improving communication

An effective two-way communication of real-time data can promote collaboration between clinical medicine and public health.

Examples of effective clinical public health from the COVID-19 pandemic

Recognizing and adopting the concept of clinical public health can foster collaboration between clinical and public health professionals to address complex health issues by enabling multidisciplinary[26] approaches to the planning and delivery of both clinical and public health services. Such collaboration can promote best practices, education, research and advocacy and close gaps and inequalities in individual and population health. Successful experiences from responses to the COVID-19 pandemic can provide a model for advancing clinical public health approaches, as in the examples below.

The contribution of public health to clinical care is perhaps best illustrated with the efforts to "flatten the curve," which became the defining slogan and graphic of the COVID-19 pandemic in 2020.[27] The strain on clinical practitioners in hospitals caused by overwhelming numbers of people becoming ill at the same time has been strategically lessened by public health and social measures such as wearing masks,[28] handwashing, physical distancing and other community mitigation to reduce disease transmission.

Similarly, clinical practitioners have worked to increase the scope and effectiveness of population-based interventions.[24] For example, they managed the care and recovery of patients in isolation due to COVID-19 infection, thereby reducing the risk of virus transmission in the community. Clinicians have been successfully promoting and advocating for adherence to public health and social measures throughout the pandemic and playing a crucial role in population health by encouraging vaccination. Clinical research on the development and testing of vaccines has also engaged both clinicians and public health professionals.

In summary, the collaboration between clinical and public health professions during the COVID-19 pandemic has been remarkable. Clinical and public health practitioners have worked to align education and public messaging on testing and public health and social measures to achieve better individual and population health, reducing the impact of the pandemic at both levels. This enhanced role provides a model for ongoing promotion and advocacy for public health policies to reduce morbidity and mortality due to other infectious and communicable diseases, injuries and chronic diseases. The collaboration should continue during the post-pandemic period.

Recommendations

The COVID-19 pandemic has provided unprecedented evidence of the importance of collaboration and coordination between clinical and public health professionals. Continuing this highly effective partnership by formalizing the concept of clinical public health is an important step towards identifying and developing new and more comprehensive solutions to population health problems, including, for example, addressing determinants of health at the individual and population level. A comprehensive framework is required to achieve common goals over the long term for the benefit of all.

A recent Lancet Commission report highlights the need for all health professionals to be skilled in individual and population-level care.[29] To accomplish this, a multiphased process might work best, by first establishing the scope of clinical public health through defined terms, and then identifying key topics for collaboration. This could be done through a working group representing multiple stakeholders, followed by a consensus building process to refine the vision and approach with a broader community of stakeholders. Building on the successes and learnings of the pandemic response, consideration could be given to starting with a sustained, collaborative approach to communicable disease prevention and control to prevent and control epidemics and pandemics.

Some of this work needs to include a broad range of health professionals. While there have been advocates of greater synergy between primary care and public health, the concept of clinical public health is broader, including collaboration with all clinical specialties and disciplines within medicine and other health care specialties.

Also, information technology solutions that connect local clinical and public health professionals could encourage data sharing and enable all relevant health professionals to be informed of the impact of collaborative interventions in real time (e.g. reporting on immunization coverage by practice and community).

Conclusion

Action to accelerate clinical public health must be taken now to sustain the collaborative successes of the pandemic response. What better legacy from the COVID-19 pandemic than adopting the concept of clinical public health to further strengthen the bonds between clinical and public health professionals to achieve better health for all?

Conflicts of interest

We declare no competing interests.

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Authors' contributions and statement

BC and RU conceptualized the design and initiated the project.

BC wrote the first draft of the paper, with input from RU.

All authors participated in the critical review of the first draft, raised critical questions and provided further inputs and references from the world literature on the topic. All authors were involved in the drafting of various sections of the manuscript, critically revised different versions and approved the final version. All authors are accountable for all aspects of the project.

BC, AK and KG contributed final inputs and editing.

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Commentary

Moment of reckoning for household food insecurity monitoring in Canada

Valerie Tarasuk, PhD; Andrée-Anne Fafard St-Germain, PhD; Timmie Li, MSCom

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Household food insecurity, inadequate or insecure access to food due to financial constraints, is a serious population health problem in Canada, linked to poorer mental health,[1-4] higher rates of infectious[5] and non-communicable diseases[6, 7] and injuries,[8] increased health care utilization,[9-12] and premature mortality.[13] Monitored since 2005 with the well-validated Household Food Security Survey Module (HFSSM) on the Canadian Community Health Survey (CCHS),[14] this problem was widespread and growing before the pandemic.[15,16] It affected 12.7% of households, about 4 370 000 people, in 2017 to 2018.[15] Recognition of the need for more effective responses was evident in two major federal policy initiatives. The Poverty Reduction Strategy, released in 2018, identified the prevalence of household food insecurity as a valuable indicator of Canadians' ability to meet basic needs,[17] prompting the addition of the HFSSM to the Canadian Income Survey (CIS) to facilitate annual reporting on the Poverty Dashboard, a website introduced to track the Strategy's key poverty indicators.[18] In 2019, household food insecurity was identified as a priority in the Food Policy for Canada.[19]

Concerns about food insecurity became heightened in the spring of 2020 as pandemic-related business closures forced thousands out of work.[20] In addition to rapidly implementing new income support and wage subsidy programs, federal and provincial governments introduced massive new funding programs for food banks and other charitable food assistance programs.[21-24] Population surveys were temporarily suspended, but in May 2020, an abbreviated measure of food insecurity was included on the Canadian Perspectives Survey Series 2 (CPSS-2). In the prior 30 days, 14.6% of respondents to this online survey reported experiencing food insecurity.[25] When compared to CCHS 2017–2018, taking into account differences in the samples and measures of food insecurity, the estimates suggest a 39% increase in the prevalence of household food insecurity since the onset of the pandemic.[25] Against this backdrop, the unprecedented investment of public funds in food charities continued through 2021.[26,27]

Statistics Canada's recent releases of results from CIS 2018, 2019[18] and 2020[28] and CCHS 2019 and 2020,[29] summarized in Figure 1, challenge the widespread perception that food insecurity has escalated through the pandemic. Yet, these surveys provide very different prevalence estimates, raising questions about which benchmark to use to track progress in addressing household food insecurity. What follows is an examination of differences and similarities among the recent data releases and a discussion of food insecurity monitoring moving forward.

Household food insecurity through the lens of the Canadian Income Survey

January 2022 marked the first public release of food insecurity data from the CIS with results for 2018 and 2019,[18] followed in March by updated estimates for CIS 2018 and 2019, plus results for 2020.[28] Based on CIS 2018, 6 099 000 people (16.8% of the population) in the 10 provinces were living in food-insecure households.[28] This number fell to 5 845 000 (15.9%) in CIS 2019, and remained relatively stable at 5 839 000 (15.8%) in CIS 2020.[28] The original report of prevalence estimates from CIS 2018 and 2019 suggests a significant decline in moderate/severe food insecurity at the 90% confidence level between the two years.[18]

Household food insecurity through the lens of the Canadian Community Health Survey

In February 2022, prevalence estimates from CCHS 2019 and 2020 were published.[29] Data are not available for all 10 provinces in CCHS 2019 because British Columbia declined to measure food insecurity during this cycle. CCHS 2020 results were based on online interviews conducted in September to December 2020 in the 10 provinces. In a departure from the prior practice of reporting CCHS prevalence estimates for households,[15] the recently published estimates represent the prevalence of household food insecurity among Canadians 12 years of age and older (the target population in CCHS).[29] This prevalence was 9.6% in 2020, a statistically significant drop from the 12.6% prevalence charted in CCHS 2017–2018 for the 10 provinces ($p < 0.001$).[29]

Comparing the results of the two surveys

To summarize, the analyses of CIS and CCHS both indicate that the prevalence of household food insecurity in Canada was lower in 2020 than it had been before the pandemic. This finding contradicts earlier reports of escalating food insecurity triggered by the pandemic,[25,30] but the decline is plausible given federal income supports, wage subsidies and various interventions

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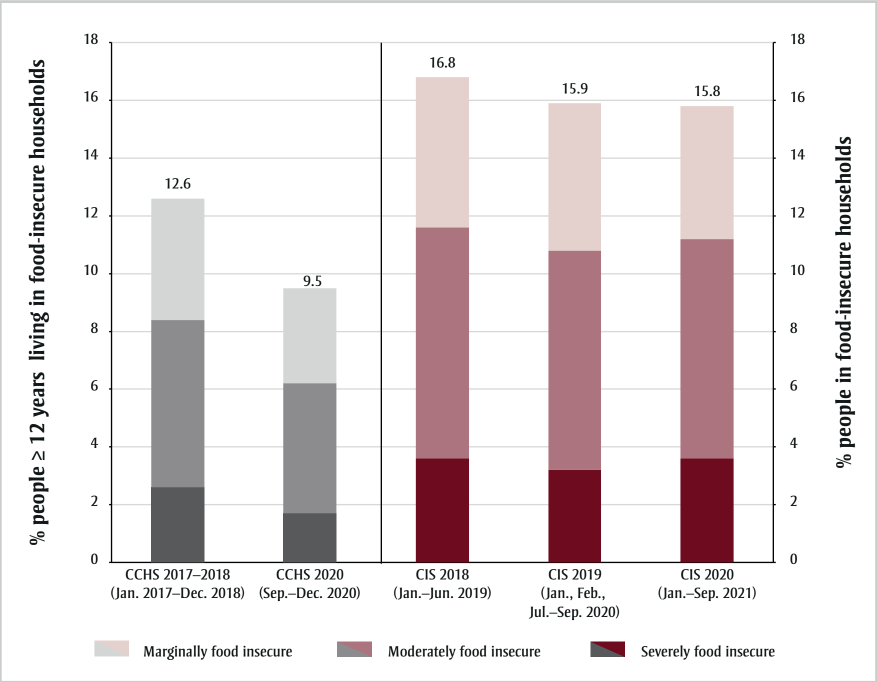
Author reference:

Department of Nutritional Sciences, Temerty Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

Correspondence: Valerie Tarasuk, Department of Nutritional Sciences, Temerty Faculty of Medicine, University of Toronto, 1 King's College Circle, Toronto, ON M5S 1A8; Tel: 416-978-0618; Email: valerie.tarasuk@utoronto.ca

FIGURE 1
Percentage of people living in food-insecure households in Canada, excluding the territories



Sources: CCHS data are from Polsky and Garriguet (2022)[29] and CIS data are from Statistics Canada (2022).[28] The survey year for CCHS refers to the year of interview, whereas survey year for CIS refers to the year prior to the year of interview. The survey collection periods are indicated in parentheses. Food insecurity is assessed over the prior 12 months.

Abbreviations: CCHS, Canadian Community Health Survey; CIS, Canadian Income Survey.

to cap or reduce living costs during this period.[31]

However, the results from CIS and CCHS provide very different impressions of the size of the problem of household food insecurity in Canada, both before and during the pandemic. The number of Canadians living in food-insecure households based on CCHS 2017–2018 is 1.7 million less than the number based on CIS 2018, and the latter estimate does not include data for the territories. The different units of analysis reported for 2020 complicate comparisons for that year, but, assuming Canadians under 12 years of age have a similar rate of food insecurity to those 12 and older, the CCHS results suggest that fewer than 1 in 10 Canadians were affected by household food insecurity in 2020,[29] whereas this ratio is closer to 1 in 6 based on the CIS results.[28]

What accounts for the difference?

Household food insecurity is similarly correlated with other indicators of social and economic disadvantage in the CCHS and the CIS,[18,29] suggesting that the surveys are capturing a similar problem. A detailed examination of household-level prevalence estimates for moderate/severe food insecurity from CIS 2018 and CCHS 2017–2018 revealed that between-survey differences in population weight calibrations and the imputation of missing responses accounted for only a small fraction of the discrepancy.[18] The authors suggested part of the explanation could lie in the higher response rate to CIS 2018 (77.4%, vs. 61.5% in CCHS 2017–2018), a phenomenon attributed to the fact that the CIS is a supplement to the mandatory Labour Force Survey.[18] While both surveys adjust for nonresponse, they do this differently, and the effects of the adjustments are impossible to gauge.[18] Additionally, some survey participants might respond differently to the HFSSM depending on whether these questions are posed in the context of questions about health and health behaviours (i.e. CCHS) or questions about employment and household economics (i.e. CIS), although any such effect is difficult to identify, let alone quantify.

The discrepancy between CCHS 2017–2018 and CIS 2018 estimates pales in comparison to the discrepancy between the estimates from CCHS 2020 and CIS 2019 and 2020. Assuming children under 12 years of age have a similar prevalence of food insecurity to those 12 and older, there is more than a six-percentage point difference in the estimates from CIS 2019 and CIS 2020 compared to CCHS 2020, even though these surveys cover a similar time period. The much lower prevalence in CCHS 2020 may relate to the very low response rate for this survey (24.6%, vs. 80.3% for CIS 2019 and 76.6% for CIS 2020),[29] but more analyses are required to assess this potential bias. The response rate draws into serious question the population representativeness and reliability of results from CCHS 2020.

Other comparators

Since its adoption by Health Canada, the HFSSM has been included in one other cross-sectional population survey conducted in the 10 provinces: the 2010 Survey of Household Spending (SHS 2010). This survey also yielded a higher prevalence of food insecurity than the CCHS. Because of an error in the administration of the 8 child-referenced items of the HFSSM on SHS 2010, household food insecurity status was determined using only the adult scale, but this yielded a weighted prevalence of 16.6% (95% CI: 15.6–18.5; estimated by the authors using the master datafile). The decision of the governments of New Brunswick and Prince Edward Island not to measure food insecurity on CCHS 2010 precludes estimation of a prevalence for all 10 provinces that year, but the national prevalence estimate from CCHS 2011 (including the territories) was 12.3%.[32]

The prevalence estimates from SHS 2010 and CCHS 2011 are not perfectly comparable, but their differences are unlikely to explain the large discrepancy. The omission of child-referenced items from SHS 2010 would only bias that estimate downward, and the inclusion of the territories in CCHS 2011 would, if anything, lead to a slightly higher prevalence than for the provinces alone. A comparison of prevalence estimates from CCHS 2010 and 2011 for provinces with data for both years indicates only one statistically significant difference: an increase in Quebec from 2010 to 2011.[32] This suggests that if we had data for all 10 provinces from CCHS 2010, the prevalence would probably be lower than the estimate from CCHS 2011. The magnitude and direction of the discrepancy between CCHS 2011 and SHS 2010 is consistent with the observed difference between pre-pandemic estimates from CCHS and CIS, adding credence to the idea that the prevalence of household food insecurity may be underestimated on CCHS.

In retrospect, had it been possible to compare the results of the CPSS-2 to pre-pandemic data from the CIS rather than the CCHS, the apparent change in food insecurity would have been more modest. Applying similar methods to the comparison undertaken with CCHS 2017–2018 that suggested a 39% increase in prevalence,[25] we estimated an 11% increase in food insecurity between CIS 2018 and CPSS-2 (authors' calculations using the master datafile). Faced with this result, the federal and provincial governments may still have chosen to allocate funds for charitable food assistance programs, but these decisions would not have then been supported by an estimate of sharply escalating food insecurity prevalence.

Where do we go from here?

As Canada begins to emerge from the pandemic and the income supports and wage subsidies implemented to deal with this crisis begin to be dismantled, it is more important than ever that we monitor the prevalence and severity of household food insecurity. Only through reliable, annual, national measurement of this problem can we begin to understand the impact of current federal and provincial/territorial government responses to it, set targets for food insecurity reduction and develop effective, evidence-based intervention strategies. With the HFSSM now included on both the CIS and CCHS, we have an important choice to make. The recent data releases indicate clearly that these two surveys are not interchangeable.

The finding that different population surveys yield different prevalence estimates is not unique to Canada. Similar discrepancies are common in the US, inarguably the world leader in food insecurity measurement. The HFSSM and its derivatives appear on several surveys there, but population prevalence estimates are derived from the Current Population Survey, selected for its large sample size, state-level representativeness and timeliness for annual reporting.[33]

We recommend that the CIS be used as the survey vehicle for all food insecurity monitoring in the future, because the consistently higher response rate of CIS suggests that this survey yields a more population-representative estimate of food insecurity than the CCHS. Given the serious health implications of household food insecurity, it is imperative that the population prevalence not be systematically underestimated.

The CIS has three other important advantages over the CCHS. First, it is designed to furnish prevalence estimates annually, enabling monitoring that can never be achieved with the CCHS, given the practice of only including the HFSSM as mandatory content on alternate cycles of that survey. Second, the timely release of data tables from the CIS[28] and regular updating of prevalence rates for moderate/severe food insecurity on the Poverty Dashboard mean that stakeholders and policy makers can use the results of this survey to inform decisions in real time.[34] We maintain that marginal food insecurity should be included in the Dashboard estimates,[16] but knowledge users can obtain this prevalence from the data tables.[28] Third, the monitoring of food insecurity via a population-based survey specifically designed to gather information on income, labour market activities and other financial circumstances facilitates policy analyses and program evaluations to inform the development of effective interventions to address food insecurity.

Our recommendation to base future food insecurity monitoring on the CIS comes with one important caveat: the CIS must include representative samples of the territories. Although the small populations in the territories mean their inclusion has little effect on national estimates,[18] Nunavut in particular has a much higher prevalence of food insecurity than any other part of Canada.[15,18] Food insecurity had continued to rise there before the pandemic despite federal investments in Nutrition North Canada, a food retail subsidy program intended to improve food access and affordability in the North.[35] Reducing food insecurity in the territories must be a national priority, and continued monitoring is critical to this mission.

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Conflicts of interest

The authors have no conflicts of interest.

Authors' contributions and statement

All authors contributed to the conceptualization, drafting and revising of this commentary. VT was responsible for acquisition of data used for the calculations reported here; AAFSG conducted the data analyses.

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At-a-glance

Characteristics of outdoor motorized scooter-related injuries: analysis of data from the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP)

Sofiia Desiateryk, BSc (1); Sarah Zutrauen, BHSc (1); Ze Wang, BSc (1); Ithayavani Iynkkaran, PhD (1); Lina Ghandour, MSc (2); Steven R. McFaull, MSc (3); Greg Butler, MSc (3); James Cheesman (3); Andre Champagne, MPH (3); Minh T. Do, PhD (1,2,4)

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Abstract

Introduction: The use of motorized scooters is gaining popularity in Canada and elsewhere. This study aims to summarize characteristics of injuries related to use of motorized scooters using data from the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) and to analyze trends. The eCHIRPP collects information associated with the injury event and clinical information related to treatment (the injured body part, the nature of the injury, injury intent and treatment received) from 11 pediatric and 9 general hospitals across Canada.

Results: A free-text search using keywords identified 523 cases related to motorized scooter injuries between January 2012 and December 2019. Most of the injuries reported were among males (62.7%). Fracture/dislocation was the most frequent injury (36.9%), and 14.3% of all patients were admitted to hospital. Joinpoint regression showed a statistically significant increase in injuries related to motorized scooter use between 2012 and 2017 (annual percent change of 18.4%).

Conclusion: Study findings indicate the need for continued preventive efforts and improved educational messages on safe riding and the importance of the use of protective equipment to prevent injuries among riders.

Keywords: *e-scooter, self-balancing scooter, hoverboard, powered scooter, injury, emergency department, eCHIRPP, protective equipment*

Highlights

- We used data from the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) to analyze electric scooter incident injuries in Canada.
- Injuries related to motorized scooter use increased statistically significantly between 2012 and 2017, and almost two-thirds of the people seen in participating emergency departments underwent treatment or observation, with one-third requiring follow-up treatment.
- Over half of the injuries were the result of a fall, and more than one-quarter occurred in traffic.
- Over one-third of the cases involved injury to more than one body part, with head injuries the most common (25% of reported incidents).
- Almost half of those who gave information on protective equipment use reported using it, most often a helmet.

Introduction

Scooters are portable mobility devices designed either as a footboard mounted on two wheels with a long steering handle or as a self-balancing unit. They are moved by pushing with one foot against the ground, or else they are powered by a motor.

The availability of motorized micromobility rental networks is increasing in Canada. The launch of a rental network in Calgary, Alberta, in July 2019 was the third most popular launch after ones in Tel-Aviv, Israel, and Paris, France.[1-3] These devices are affordable to rent, accessible for most people and considered environmentally friendly; these characteristics, together with the reduced parking fees and traffic time that scooter use offers, are appealing factors.[3-5]

The increased use of motorized scooters, some with speeds of up to about 50 km/h (≈ 30 miles/hour), has resulted in an increase in the number of traffic incidents associated with them.[6-8] People riding motorized scooters in bicycle lanes are more likely than car drivers to suffer non-fatal and fatal injuries following a traffic collision.[6] A recent study analyzing data from the National Electronic Injury

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Author references:

1. Department of Health Sciences, Carleton University, Ottawa, Ontario, Canada
2. Consumer and Hazardous Products Safety Directorate, Health Canada, Ottawa, Ontario, Canada
3. Public Health Agency of Canada, Ottawa, Ontario, Canada
4. Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada

Correspondence: Minh T. Do, Department of Health Sciences, Carleton University, 2305 Health Sciences Building, 1125 Colonel By Drive, Ottawa, ON K1S 5B6; Tel: 613-901-9632; Email: minh.do@carleton.ca

Surveillance System (NEISS) found over two-fold increases (222%, $p = 0.01$) in electric scooter injuries and hospital admissions in the United States between 2014 and 2018.[9]

A 2021 review of the literature on motorized scooter injuries by the Ontario Agency for Health Protection and Promotion[10] and a multicentre evaluation of emergency department data from Calgary[3] suggest there is a need for evidence specific to the mechanism (cause) of injury and type of injuries from motorized scooter use to inform and evaluate potential pilot programs and to develop recommendations. The increase in motorized scooter availability highlights the need for surveillance of injuries related to their use to better understand the nature of injury occurrence and to establish and evaluate effective preventive methods.

As such, the objective of this analysis is to describe injuries related to motorized scooter use.

Methods

Data source

Data for this study were collected by the electronic Canadian Hospitals Injury Reporting Prevention Program (eCHIRPP). eCHIRPP is a sentinel injury and poisoning surveillance system that collects data on injured individuals of all ages presenting to an emergency department at 11 pediatric and 9 general hospitals across Canada.[11] In the emergency department, the injured person or accompanying caregiver is asked to complete a questionnaire including the details associated with the injury event (i.e. "what went wrong?"). The hospital staff add clinical information—the injured body part; the nature of the injury (e.g. fracture, concussion, poisoning); whether the injury was intentional, accidental or undetermined/unknown; where the injury occurred (geographical location); and the treatment received, if any. All these details, together with extracts from patients' health information, are entered into the eCHIRPP database by trained data coders.

Extraction of cases

We searched the eCHIRPP database for all incidents of injuries related to use of motorized scooters recorded between April 2011 and September 2020. We used a free-text search feature with the keywords "motorized scooter," "e-scooter," "self-balancing scooter," "trottinette," "micro scooter," "powered scooter," "hoverboard" and "Segway." Only 9 months of data were available for 2011 and 2020, so incidents from 2011 (n = 48) and 2020 (n = 77) were excluded. Incidents that occurred indoors (n = 151) were also excluded as these occurred during misuse. In total, 523 motorized scooter incidents from between 2012 and 2019 were included in this study.

Variables of interest

Variables of interest included age group, sex, location, protective equipment, substance use, external cause, time, injury characteristics (body part injured and nature of injury) and treatment received in the emergency department.

Statistical analysis

Descriptive analyses were conducted to summarize patient demographics and injury characteristics overall and stratified by sex. Frequency distributions in the form of counts and percentages were generated for all variables. Proportions of motorized scooter-related injuries per 100000 eCHIRPP records, stratified by sex, age group and year were generated. Injury trends over time were explored.

Data analysis was conducted using Excel 2010 (Microsoft Corp., Redmond, WA, US) and Joinpoint Regression Program version 4.8.0.1 (SEERStat, NCI, Bethesda, MD, US).

Results

Demographic characteristics

A total of 523 cases of motorized scooter injuries were identified over the study period. The majority of people injured were male (62.7%) and between 10 and 14 years old (34.4%) (see Table 1).

Of the 426 patients (81.5%) who gave information on protective equipment use, 235 (44.9%) reported using it (47.3% of males and 41.0% of females); in 99.8% of these cases, this was a helmet. Over half (56.0%) of the injuries were the result of a fall, and more than one-quarter (28.5%) of incidents occurred in traffic. Injuries resulting from falls and getting struck by/against objects were more common among females (65.6% and 6.2%, respectively) than males (50.3% and 2.7%, respectively). A greater proportion of males (33.8%) than females (19.5%) were injured in traffic.

Of the 523 incidents analyzed, information on substance use at the time of the injury was provided in 239 (45.7%) cases; of these, 6 (2.5%), all of whom were male, reported that they had used a substance.

The highest number of incidents occurred during the summer months, with 15.3% in June, 13.4% in July and 16.6% in August, coinciding with the warmer months of the Canadian climate. The overall yearly trend of injuries increased between April 2011 and September 2020. Analyses of annual trends showed that the highest reported incidence occurred in 2017 (21.2%) and 2018 (21.0%) (data not shown).

Proportionally, age-specific injuries were most common in adults between 40 and 49 years old (89.6 per 100 000 eCHIRPP incidents). Children between the ages of 2 and 9 years had the lowest proportion of injuries related to motorized scooter use (28.5 per 100 000 eCHIRPP incidents).

Injury characteristics and outcome

Of the patients with motorized scooter injuries reporting to participating emergency departments, 35% injured more than one body part (Table 2). Head injuries, including of the face and mouth, were reported in a quarter (25.2%) of incidents, followed by injuries to the wrist (18.2%) and forearm (15.5%).

The most common injury diagnosis reported was fracture or dislocation (36.9%) followed by superficial (18.0%) and soft tissue (13.2%) injuries. A higher proportion of males than females experienced open wounds including minor cuts and lacerations (9.4% vs. 6.9%) and superficial injuries (20.7% vs. 13.0%). Females experienced twice as many sprains or strain injuries (11.1% vs. 4.6%), more fractures and dislocations (41.0% vs. 34.7%) and more soft tissue injuries (13.8% vs. 12.9%).

Almost two-thirds of patients (63.7%) underwent treatment or observation in the emergency department, with 33.1% requiring follow-up and 30.6% recommended follow-up as needed. Hospital admission

TABLE 1
Demographic and injury characteristics of incidents related to motorized scooter[a] use, eCHIRPP, 2012–2019

Characteristic	n (%)		
	Male (n = 328)	Female (n = 195)	Total (n = 523)
Age group in years			
2–9	68 (20.7)	51 (26.2)	119 (22.8)
10–14	100 (30.5)	80 (41.0)	180 (34.4)
15–19	68 (20.7)	24 (12.3)	92 (17.6)
20–29	16 (4.9)	4 (2.1)	20 (3.8)
30–39	11 (3.4)	3 (1.5)	14 (2.7)
40–49	18 (5.5)	13 (6.7)	31 (5.9)
50+	46 (14.0)	20 (10.3)	66 (12.6)
Protective equipment use[b]			
Yes	155 (47.3)	80 (41.0)	235 (44.9)
No	115 (35.1)	76 (39.0)	191 (36.5)
Unknown	58 (17.7)	39 (20.0)	97 (18.5)
Self-reported substance use			
Yes	6 (1.8)	–	6 (1.1)
No	144 (43.9)	89 (45.6)	233 (44.6)
Unknown	178 (54.3)	106 (54.4)	284 (54.3)
External cause			
Falls	165 (50.3)	128 (65.6)	293 (56.0)
Transport injuries in traffic	111 (33.8)	38 (19.5)	149 (28.5)
Struck by or against objects	9 (2.7)	12 (6.2)	21 (4.0)
Other or unknown unintentional injury	8 (2.4)	3 (1.5)	11 (2.1)
Missing	35 (10.7)	14 (7.2)	49 (9.4)

Abbreviation: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

Note: All percentages are column percentages.

[a] Motorized scooter incidents are defined as those that resulted in injury of the riders who were seen at participating hospital emergency departments.

[b] In 99.8% of cases where protective equipment was used, this was a helmet.

was reported for 14.3% of patients (n = 75; 70.6% males).

Joinpoint regression showed a statistically significant increase in injuries related to motorized scooter use between 2012 and 2017 (annual percent change of 18.4%, $p = 0.019$).

Discussion

The objective of this study was to examine injuries related to motorized scooter use in terms of the demographic, and injury cause, nature and outcome characteristics. The number of injuries related to motorized scooter use indicate an increasing trend from 2012 to 2017 with an 18.4 annual percent change. The literature suggests that the increasing number of injuries was directly related to a rise in sales and use of motorized scooters.[9,15]

Injuries most commonly occurred among children between 10 and 14 years old (34.4%). Further, the most common causes of injuries were falls (56.0%), which is consistent with previous reports.[10,16,17] Studies suggest that the risk for falls is higher for children because of their lower body weight, higher centre of gravity and underdeveloped body coordination.[14,17,18]

The literature suggests that the majority of hospital admissions occurred following head injuries, severe injury complexes and infection caused as a result of a fall.[17] Our study found that head injures represented the largest proportion of all injuries (25.2%) and that less than half of those who gave information on their use of protective equipment used some (44.9%), and in most cases, it was a helmet. This is also consistent with existing literature[8-10,12-14] and supports the need for safety promotion and legislation requiring protective equipment use when riding motorized scooters. The use of wrist guards and elbow pads may prevent injuries of the wrist and forearm and subsequently lower the occurrence of fractures and dislocations as well as sprains.[12,14-17]

Injuries occurred in traffic in 28.5% of incidents, and 14.3% of all incidents resulted in a hospital admission. Recent studies have shown that collisions involving motorized scooter riders and motor vehicles can result in serious injuries and death.[8,19-21] This, together with our study findings, underlines the need to control the use of motorized scooters in high traffic areas. No fatalities were identified in the eCHIRPP database because emergency department data do not capture information about people who died before they could be taken to hospital or after being admitted.[11]

Limitations

eCHIRPP's sentinel surveillance system collects data from participating hospitals across Canada, and thus data may not be representative of injury patterns across the entire country. Some populations may be overrepresented in the eCHIRPP database, that is, pediatric populations in urban centres. Conversely, the data used in this study may provide an underestimation of injuries, since they were not included in our analysis in the following cases: injured riders who did not seek treatment at a participating emergency department; older teenagers and adults who were seen at non-participating general hospitals; injuried people who sought care at walk-in clinics; or the injured riders who were Inuit, First Nations or other people living in rural and remote areas. Lastly, we carried out free-text keyword searches to identify injury incidents in the database. This strategy can introduce bias through the lack of knowledge of potential keyword search terms, use of overly specific terms or misclassification.

Conclusion

This study provides a descriptive overview of 523 motorized scooter-related injury incidents reported to eCHIRPP

TABLE 2
Characteristics of outdoor motorized scooter injury, eCHIRPP, 2012–2019

Characteristic	n (%)		
	Male (n = 328)	Female (n = 195)	Total (n = 523)
Body part (all that apply)			
Head, face, mouth	86 (26.2)	46 (23.6)	132 (25.2)
Neck, spine, back	31 (9.5)	9 (4.6)	40 (7.6)
Thorax, abdomen, pelvis	35 (10.7)	10 (5.1)	45 (8.6)
Shoulder, clavicle, upper arm	31 (9.5)	16 (8.2)	47 (9.0)
Elbow	32 (9.8)	17 (8.7)	49 (9.4)
Forearm, including radius, ulna	47 (14.3)	34 (17.4)	81 (15.5)
Wrist, including carpal bones	53 (16.2)	42 (21.5)	95 (18.2)
Hand, finger or thumb	24 (7.3)	16 (8.2)	40 (7.6)
Hip and thigh	17 (5.2)	8 (4.1)	25 (4.8)
Knee	27 (8.2)	22 (11.3)	49 (9.4)
Lower leg	20 (6.1)	16 (8.2)	36 (6.9)
Ankle	23 (7.0)	18 (9.2)	41 (7.8)
Foot and toe	27 (8.2)	4 (2.1)	31 (5.9)
Multiple injuries of >1 body part	116 (35.4)	67 (34.4)	183 (35.0)
Body part not required[a]	7 (2.1)	1 (0.5)	8 (1.5)
Unspecified body part / blank on questionnaire	2 (0.6)	3 (1.5)	5 (1.0)
Nature of injury			
Superficial	99 (20.7)	34 (13.0)	133 (18.0)
Open wound	45 (9.4)	18 (6.9)	63 (8.5)
Fracture and dislocation	166 (34.7)	107 (41.0)	273 (36.9)
Sprain or strain	22 (4.6)	29 (11.1)	51 (6.9)
Soft tissue injury	62 (12.9)	36 (13.8)	98 (13.2)
Minor closed head injury or concussion	34 (7.1)	19 (7.3)	53 (7.2)
Major head injury (intracranial)	9 (1.9)	1 (0.4)	10 (1.4)
Injury to nerve, muscle or tendon	10 (2.1)	6 (2.3)	16 (2.2)
Internal organ	12 (2.5)	2 (0.8)	14 (1.9)
Other	5 (1.0)	4 (1.5)	9 (1.2)
Not specified and blanks	15 (3.1)	5 (1.9)	20 (2.7)
Treatment/disposition			
Advice only, diagnostic testing, referred to GP (no treatment in ED)	66 (20.1)	47 (24.1)	113 (21.6)
Treated or observed in ED, follow-up as needed	104 (31.7)	56 (28.7)	160 (30.6)
Treated or observed in ED, follow-up required	104 (31.7)	69 (35.4)	173 (33.1)
Admitted to this or another hospital primarily for injury treatment	53 (16.2)	22 (11.3)	75 (14.3)
Missing	1 (0.3)	1 (0.5)	2 (0.4)

Abbreviations: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program; ED, emergency department; GP, general practitioner.

[a] Body part not required includes poisoning or toxic effect; drowning or immersion; asphyxia or other threat to breathing; systemic overexertion; heat/cold stress; mental health; and when no injury is detected.

between 2012 and 2019. We identified a large proportion of head, forearm and wrist injuries related to motorized scooter use.

These findings underscore the need for continued preventive efforts and improved educational messages on safe riding practices and the use of protective equipment to prevent injuries. Future work involving continued surveillance and research of motorized scooter-related injuries is needed to better inform injury prevention in light of the growing popularity of motorized scooters and their use as a means of transportation.

Conflicts of interest

The authors have no conflicts to declare.

Authors' contributions and statement

SD, MTD, SZ, II, LG, ZW, SRM, JC, AC and GB were involved in the project design and conceptualization.

SD conducted the literature review search and data analyses and drafted the manuscript.

SRM, AC and JC extracted the eCHIRPP data.

All authors contributed to revising the article.

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