

# Test ordering for preventive health care among family medicine residents

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## Abstract

**Objective** To determine which screening tests family medicine residents order as part of preventive health care.

**Design** A cross-sectional survey.

**Setting** Alberta and Ontario.

**Participants** First- and second-year family medicine residents at the University of Alberta in Edmonton, the University of Calgary in Alberta, and McMaster University in Hamilton, Ont, during the 2011 to 2012 academic year.

**Main outcome measures** Demographic information, Likert scale ratings assessing ordering attitudes, and selections from a list of 38 possible tests that could be ordered for preventive health care for sample 38-year-old and 55-year-old female and male patients. Descriptive and comparative statistics were calculated.

**Results** A total of 318 of 482 residents (66%) completed the survey. Recommended or appropriate tests were ordered by 82% (for cervical cytology) to 95% (for fasting glucose measurement) of residents. Across the different sample patients, residents ordered an average of 3.3 to 5.7 inappropriate tests per patient, with 58% to 92% ordering at least 1 inappropriate test per patient. The estimated average excess costs varied from \$38.39 for the 38-year-old man to \$106.46 for the 55-year-old woman. More regular use of a periodic health examination screening template did not improve ordering ( $P = .88$ ).

**Conclusion** In general, residents ordered appropriate preventive health tests reasonably well but also ordered an average of 3.3 to 5.7 inappropriate tests for each patient. Training programs need to provide better education for trainees around inappropriate screening and work hard to establish good ordering behaviour in preparation for entering practice.

## EDITOR'S KEY POINTS

- Preventive health care (PHC) is integral to primary care, but physicians frequently do not meet PHC recommendations. Failing to order appropriate tests can lead to missed opportunities to reduce morbidity and mortality, and ordering inappropriate tests can increase costs and potentially cause unintended harm. It is essential that residents learn appropriate PHC screening in training. This study aimed to assess residents' PHC test ordering.
- The authors found that family medicine residents order recommended screening tests appropriately but also excessively order unnecessary screening tests (average of 4.6 inappropriate tests per patient). The excess ordering leads to unnecessary costs of between \$38.39 and \$106.46 for sample 38-year-old and 55-year-old male and female patients.
- The use of templates for the periodic health examination does not improve ordering. Teachers and preceptors should provide more education and positive role modeling to improve test ordering for PHC.



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Preventive health care (PHC) is an integral part of primary care practice. Unfortunately, previous studies have shown that physicians frequently do not meet recommendations for PHC.<sup>1-3</sup> Failing to order appropriate tests could lead to missed opportunities to reduce morbidity and mortality, while ordering inappropriate tests could increase costs and potentially cause unintended harm. Therefore, learning and implementing appropriate PHC screening in training is essential in order to ingrain good PHC practice early.

A few studies have investigated residents' recommendation of 2 to 3 appropriate PHC screening tests and found colon cancer, breast cancer, and lipid screening rates were generally between 80% and 90%.<sup>4,5</sup> Another study examined residents' routine ordering of 3 inappropriate tests and found approximately 5% ordered routine electrocardiograms, 12% ordered complete blood counts (CBCs), and 51% ordered urinalysis.<sup>6</sup> We could not identify any studies that examined residents' ordering of a broad range of tests for PHC.

While undoubtedly time requirements present a challenge to PHC,<sup>7</sup> some evidence suggests that residents might lack understanding of some aspects of PHC, such as colon cancer screening.<sup>8</sup> It is important that we begin to assess what family medicine residents believe to be appropriate test ordering for PHC so that we can determine if deficits exist and modify our training programs if necessary. This could in turn help residents improve their performance for PHC and enhance care for patients. The selective use of tests will not only improve screening but also prevent unnecessary testing and the potential consequences of those errors while reducing costs.

Our primary objective was to determine what tests residents thought were appropriate for PHC screening. Secondary objectives were to assess attitudes around the use of PHC screening templates in practice and any association between test ordering and demographic characteristics or attitudinal responses.

## METHODS

### Survey development

We used the Dillman total design method<sup>9</sup> to develop and distribute a questionnaire. We collected demographic data on residency year (first or second), program location (rural or urban), university (McMaster University, University of Calgary, or University of Alberta), sex, and location of medical school graduation (Canadian or international).

To assess residents' attitudes about test ordering and the use of PHC checklists or templates, we asked 5 questions:

- When available, do you follow a template for routine health examinations?

- Do you feel you are ordering less, the same, or more than a template (if available)?
- Do you think the template you are using encourages you to order less, the same, or more?
- Do you feel you are ordering less, the same, or more than your preceptor?
- After graduation do you feel you would order less, the same, or more than as a resident?

Answers were provided on a 5-point Likert scale from 1 meaning "never" or "a lot less" to 5 meaning "always" or "a lot more." We also asked residents if they would order any "baseline" screening tests and what they would be.

In order to more broadly assess residents' PHC test ordering for adults we wanted sample middle-aged patients who would require little to no screening, as well as slightly older patients who would meet the criteria for most adult screening maneuvers. Our final group included 4 patients: female and male 38-year-old patients, as well as female and male 55-year-old patients. We also wanted to offer residents a large choice of tests to select from. The 38 investigations listed included 29 blood tests, 3 urine tests (urine analysis, microalbumin-creatinine ratio, and chlamydia and gonococcus screening), 3 imaging tests (chest x-ray scan, mammogram, and bone mineral density testing), electrocardiogram, cervical cytology, and fecal occult blood testing. We used the Preventive Care Checklist<sup>10,11</sup> endorsed by the College of Family Physicians of Canada as our criterion standard for appropriate screening tests.

Together, D.F. and G.M.A. developed the survey. It was then distributed to the other clinician researchers (I.S., C.A.M., F.M.A., and A.K.) and modifications were made based on their suggestions. It was then reviewed by 3 practising clinicians to ensure clarity. The final distributed survey is available upon request.

### Survey distribution

During the 2011 to 2012 academic year, we surveyed all family medicine residents from 3 university programs in Ontario and Alberta: McMaster University in Hamilton, Ont, the University of Calgary in Alberta, and the University of Alberta in Edmonton. The first distribution of the survey was done in person at a resident meeting day, such as an academic session or special program-wide training seminar. The local resident involved in the project (A.K., D.F.) performed the in-person distribution for their programs, except at McMaster where the faculty member (I.S.) filled in, as the resident (F.M.A.) was unavailable. Residents who did not respond to the first distribution received the survey up to 2 more times via e-mail at 6-week intervals. E-mail messages linked to a SurveyMonkey version of the questionnaire. To improve the response rate, residents completing the survey were entered into a draw for a chance to win 1 of 7 restaurant gift cards worth \$25.

Ethics approval was obtained from the ethics boards of all 3 participating universities.

**Data analysis**

Descriptive statistics were performed for demographic characteristics, attitudinal questions, and ordering of tests. In order to broadly explore potential associations, we performed a large number of statistical comparisons (124 total). To reduce the risk of spurious results, we used an  $\alpha$  value of 0.01 for statistical significance.

In general, Likert scale outcomes were analyzed using either the *t* test, for dichotomous comparisons, or ANOVA (analysis of variance), for comparisons with more than 2 categories. Fisher exact test was used to compare 2 dichotomous outcomes. The Cochran-Armitage trend test (for the single appropriate test in the 38-year-old female) and Jonckheere-Terpstra tests (all other comparisons) were used to assess if ratings on attitudinal Likert scales were associated with appropriate or inappropriate ordering in any of the 4 patients or in all 4 combined.

We also examined the costs of test ordering, both appropriate and inappropriate. We used full cost recovery pricing (including everything from technician time to tray fee to floor cleaning) attained from Alberta Health Services laboratory and the Alberta Health fee guide. Specific cost information is available from the authors on request.

In 2 cases, tests might have overlapped. A CBC with or without white blood cell (WBC) differential would include measurement of hemoglobin level, and electrolyte measurement would include sodium and potassium levels. We performed a sensitivity analysis of the number of tests ordered when hemoglobin was excluded if CBC with or without WBC differential was also ordered, and sodium and potassium were excluded when electrolyte measurement was ordered.

A post hoc analysis was performed to determine if one test (a sentinel) might identify residents more likely to order inappropriate tests. We compared the number of inappropriate tests ordered by residents ordering a CBC with or without WBC differential in a 38-year-old man with those who did not.

**RESULTS**

Of the potential 482 family medicine residents surveyed at the 3 universities, 318 (66%) responded. Demographic details of the residents are provided in **Table 1**.

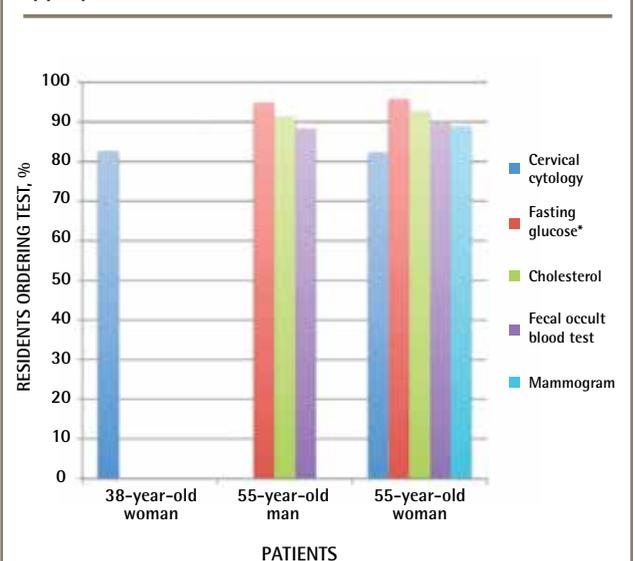
For the 4 possible patients, residents ordered an average of 26.7 tests, 8.4 of which were appropriate and 18.3 of which were inappropriate. The proportions of appropriate tests ordered are provided in **Figure 1**. Depending on the test, 82% to 96% of residents ordered the appropriate tests.

**Table 1. Demographic characteristics of participating residents: A total of 318 of 482 (66%) residents participated.**

CHARACTERISTICS	N (%)*
Residency year	
• First	189 (61)
• Second	121 (39)
Program location	
• Urban	226 (79)
• Rural	60 (21)
University	
• Alberta	84 (29)
• Calgary	96 (33)
• McMaster	112 (38)
Sex	
• Female	169 (58)
• Male	121 (42)
Country of medical graduation	
• IMG	40 (14)
• CMG	249 (86)

CMG—Canadian medical graduate, IMG—international medical graduate. \*Not all residents answered all questions.

**Figure 1. Proportion of residents ordering appropriate tests**



\*Fasting glucose was ordered in 94% of 55-year-old men and 95% of 55-year-old women. Hemoglobin A<sub>1c</sub> was ordered in 20% of 55-year-old men and 20% of 55-year-old women. At least 1 glucose test was ordered in 95% of 55-year-old men and 96% of 55-year-old women.

For the 38-year-old female patient, residents on average ordered 4.8 tests, 4.0 of which were inappropriate. For the 38-year-old male patient, residents on average

ordered 3.3 tests, all inappropriate. For the 55-year-old female patient, residents ordered 10.4 tests, 5.7 of which were inappropriate. For the 55-year-old male patient, residents ordered 8.2 tests, 5.3 of which were inappropriate. At least 1 inappropriate test was ordered by 73% of residents for the 38-year-old female patient, 58% of residents for the 38-year-old male patient, 92% of residents for the 55-year-old female patient, and 89% of residents for the 55-year-old male patient.

The most common inappropriate tests, by patient type, are provided in **Table 2**. A CBC with or without WBC differential and measurement of thyroid-stimulating hormone, creatinine, and electrolyte levels were consistently ordered excessively for all 4 patients. No demographic variable had a statistically significant association with the average number of inappropriate tests ordered for all 4 patients (**Table 3**). Demographic variables did not have a statistically significant association with the ordering of inappropriate tests for any of the 4 individual patients either (data not shown, all *P* values  $\geq .03$ ). In terms of appropriate tests, female residents were more likely than male residents (90% vs 74%) were to order cervical cytology (the only appropriate test) for the 38-year-old woman (*P* < .001). Otherwise, no demographic variable had a statistically significant association with the ordering of appropriate tests for any individual patient or all patients combined (data not shown, all *P* values  $\geq .4$ ).

Ordering inappropriate tests led to a mean (SD) excess cost of \$66.53 (\$66.76) per patient. Unnecessary laboratory costs accounted for a mean (SD) of \$51.29 (\$44.01) of the excess costs, with unnecessary radiology accounting for a mean (SD) of \$15.23 (\$44.30) of

the remainder. By patient, residents' mean (SD) excess cost from unnecessary testing was \$57.34 (\$51.93) for the 38-year-old woman, \$38.39 (\$42.03) for the 38-year-old man, \$106.46 (\$88.68) for the 55-year-old woman, and \$63.93 (\$55.30) for the 55-year-old man.

A few of the demographic characteristics seemed to influence the scores on attitudinal Likert rankings (**Table 4**). However, of the 4 statistically significant results, 3 involved a difference of less than 0.5 in the mean Likert rankings; while these differences are statistically significant, they are likely not meaningful differences. McMaster residents had an average Likert score for following a template of 4.16 compared with residents from the University of Calgary at 3.58 and the University of Alberta at 3.17 (*P* < .001).

Scores on attitudinal Likert rankings were not associated with appropriate ordering for individual patients or for all patients combined (data not shown, *P*  $\geq .09$ ). Inappropriate test ordering by attitudinal Likert rankings is provided in **Table 5**. Residents scoring higher for "Do you feel you are ordering less, the same, or more than a template?" were more likely to order more inappropriate tests than those who scored the question lower (*P* = .001 for all 4 patients together). Residents scoring higher for "Do you feel you are ordering less, the same, or more than your preceptor?" were more likely to order more inappropriate tests than those who scored the question lower (*P* = .01 for all 4 patients together).

In the sensitivity analysis excluding all potential duplicates, residents ordered 24.0 tests for all 4 patients; 8.4 were appropriate and 15.5 were inappropriate. Thus, duplicate ordering would have accounted for 2.8 inappropriate tests (18.3 minus 15.5) over 4 patients.

**Table 2. Six most common inappropriate tests ordered by residents for each sample patient**

TESTS	PROPORTION OF RESIDENTS ORDERING TEST			
	38-YEAR-OLD WOMAN	38-YEAR-OLD MAN	55-YEAR-OLD WOMAN	55-YEAR-OLD MAN
CBC with or without WBC differential	52	47	77	74
Electrolytes	27	26	46	45
Creatinine	33	33	66	65
TSH	32	22	48	37
Fasting glucose	32	32	NA	NA
ALT	NA	NA	35	34
Miscellaneous				
• Chlamydia and gonorrhea	33*	NA	NA	NA
• Cholesterol	NA	23	NA	NA
• BMD	NA	NA	32	NA
• PSA	NA	NA	NA	38

ALT—alanine aminotransferase, BMD—bone mineral density, CBC—complete blood count, NA—not applicable, PSA—prostate-specific antigen, TSH—thyroid-stimulating hormone, WBC—white blood cell.

\*At McMaster, chlamydia and gonorrhea testing is promoted as part of screening for this type of patient. Chlamydia and gonorrhea testing was ordered by 25% of University of Alberta and 24% of University of Calgary residents compared with 49% of McMaster residents (post hoc comparison, University of Alberta and University of Calgary pooled vs McMaster, *P* = .003).

**Table 3. Factors influencing overall ordering of inappropriate tests for all patients combined**

CHARACTERISTIC	AVERAGE NO. OF INAPPROPRIATE TESTS ORDERED	P VALUE
Residency year		.04
• First	16.8	
• Second	20.4	
Program location		.05
• Urban	17.1	
• Rural	21.2	
University		.51
• Alberta	19.1	
• Calgary	16.6	
• McMaster	17.3	
Sex		.60
• Female	17.6	
• Male	18.5	
Country of medical graduation		.78
• IMG	18.5	
• CMG	17.8	

CMG—Canadian medical graduate, IMG—international medical graduate.

Residents who ordered a CBC with or without WBC differential for the 38-year-old man ordered a total of 28.3 additional inappropriate tests, which was significantly more than the 8.5 total inappropriate tests ordered by residents who did not order the CBC with or without WBC differential for the 38-year-old man ( $P < .001$ ).

## DISCUSSION

Approximately 90% of family medicine residents from 3 Canadian universities indicated they would order the appropriate screening tests for 38-year-old and 55-year-old female and male patients. Although 17% to 18% of residents did not indicate they would order cervical cytology for 38-year-old and 55-year-old women, it is possible that some did not because guidelines now recommend the test every 3 years (assuming no past positive results). There was no association between demographic characteristics or attitudinal rankings except that female residents were more likely than male residents were to order cervical cytology for the 38-year-old woman. Overall, it appears that most residents understand and order the appropriate, recommended screening tests.

Perhaps the more important result was the pervasive excess ordering of inappropriate and unnecessary tests. For the 38-year-old male patient, 58% of residents ordered at least 1 inappropriate test, and for the 55-year-old female patient, 92% ordered at least 1 inappropriate test. The

mean number of inappropriate tests per patient varied from 3.3 to 5.7, which means additional unnecessary costs of \$38.39 to \$106.46. Taken over millions of patients per year, the inappropriate testing would result in multiple false-positive results, unnecessary worry, and obligatory follow-up testing, and would likely cost hundreds of millions of wasted dollars.

As templates and checklists, frequently integrated into electronic health records, become more common, we wondered if these might be having an effect on preventive health test ordering. That was not the case. Further, although McMaster residents reported using templates significantly more often ( $P < .001$ ), this did not reduce inappropriate testing. In some cases, the templates themselves are generated by the clinic or clinician and are likely not following appropriate testing recommendations. Additionally, as shown in our study, clinicians might have recognized that they were ordering more than their colleagues were or than what was recommended by checklist templates but did so anyway. Residents who thought they were ordering more than templates recommended or preceptors ordered were ordering approximately 6 to 8 tests more (over 4 patients) than those who thought they were ordering fewer. Although residents in second year, those in rural programs, and those from the University of Alberta ordered more inappropriate tests, none of the differences was statistically or meaningfully different (average difference < 1 extra inappropriate test per patient).

Past research suggests residents might have lower adherence to preventive health maneuvers than nurse practitioners do,<sup>12</sup> but in our study their adherence to recommended maneuvers was quite good. Zallman and colleagues<sup>6</sup> found residents were at least as likely to perform preventive health maneuvers as staff physicians were.<sup>6</sup> Our research suggests that residents have a pretty good grasp of appropriate test ordering for PHC, and only minor efforts would be needed to enhance uptake further.

The bigger issue by far is the excessive ordering of inappropriate tests. The reasons for inappropriate test ordering by residents likely begin with medical school education. However, residency training is certainly not improving things, as inappropriate ordering was the same or worse in second year. Different schools and different programs (rural vs urban) did not fare any differently, meaning no group is immune. Is this a problem with education within programs or with preceptors and faculty not serving as adequate role models? It is likely both.

Why might it be that physician teachers are not helping learners reduce inappropriate test ordering? The messaging around the inappropriate nature of tests like urinalysis and CBC has been clear for decades.

**Table 4. Ordering influences and demographic characteristics: Mean ratings on a 5-point Likert scale from less to more or rarely to always.**

CHARACTERISTIC	MEAN RATING				
	DO YOU FOLLOW A TEMPLATE?	DO YOU FEEL YOU ORDER LESS OR MORE THAN THE TEMPLATE?	DOES THE TEMPLATE ENCOURAGE LESS OR MORE ORDERING?	DO YOU ORDER LESS OR MORE THAN YOUR PRECEPTOR?	AFTER GRADUATION, WILL YOU ORDER LESS OR MORE?
Residency year					
• First	3.61	2.92	3.13	3.01	2.75
• Second	3.87	3.15	2.97	3.00	2.99
• P value	.06	.02	.10	.94	.003
Program location					
• Urban	3.75	3.01	3.06	3.06	2.83
• Rural	3.37	2.95	3.17	2.75	2.83
• P value	.03	.66	.41	.01	>.99
University					
• Alberta	3.17	2.99	3.15	2.82	2.77
• Calgary	3.58	2.95	2.92	2.95	2.78
• McMaster	4.16	3.07	3.11	3.23	2.95
• P value	<.001	.59	.15	<.001	.12
Sex					
• Female	3.82	3.01	3.07	3.09	2.87
• Male	3.50	2.97	3.07	2.90	2.82
• P value	.02	.77	>.99	.06	.54
Country of medical graduation					
• IMG	4.08	2.92	3.03	3.10	2.75
• CMG	3.61	2.99	3.09	3.00	2.86
• P value	.02	.68	.67	.53	.38

CMG—Canadian medical graduate, IMG—international medical graduate.

**Table 5. Average number of inappropriate tests ordered per patient by attitudinal responses: The Jonckheere-Terpstra test was used to determine if responses were associated with inappropriate test ordering.**

LIKERT RESPONSE	AVERAGE NO. OF INAPPROPRIATE TESTS				
	38-YEAR-OLD WOMAN	38-YEAR-OLD MAN	55-YEAR-OLD WOMAN	55-YEAR-OLD MAN	OVERALL
Do you follow a template?					
• Never or rarely	4.4	3.8	5.6	5.0	18.8
• Half the time	3.9	3.3	4.6	4.4	16.1
• Most times or always	3.9	3.2	5.9	5.5	18.6
• P value	.63	.17	.11	.15	.88
Do you feel you order less or more than the template?					
• A lot or a little less	3.3	2.7	5.0	4.6	15.7
• Same	3.8	3.1	5.4	5.0	17.3
• A lot or a little more	5.4	4.7	7.0	6.5	23.6
• P value	.02	.007	.03	.002	.001
Does the template encourage less or more ordering?					
• A lot or a little less	4.7	4.0	6.1	5.6	20.4
• Same	4.2	3.5	6.0	5.5	19.2
• A lot or a little more	3.7	2.9	5.4	5.1	17.1
• P value	.43	.22	.35	.37	.32
Do you order less or more than your preceptor?					
• A lot or a little less	3.6	2.9	4.7	4.3	15.5
• Same	3.8	3.1	5.5	5.1	17.5
• A lot or a little more	4.7	3.9	6.7	6.3	21.6
• P value	.16	.13	.003	.001	.01
After graduation, will you order less or more?					
• A lot or a little less	4.5	3.8	6.0	5.3	19.7
• Same	3.7	3.0	5.4	5.1	17.3
• A lot or a little more	4.1	3.6	6.3	6.0	20.0
• P value	.36	.67	.90	.51	.85

Despite this, recent research shows each of these tests is ordered in 18% to 56% of ambulatory visits for PHC.<sup>13,14</sup> So, what drives clinicians to order tests that are inappropriate? There is a long list of factors contributing to inappropriate ordering, including patient requests,<sup>15</sup> fear of missing something,<sup>16</sup> being in solo practice,<sup>16</sup> and fear of litigation.<sup>16</sup> As the causes are multifactorial, likely the solutions are too. Multiple studies have shown moderate reduction in unnecessary testing with interventions like clinical outreach facilitation,<sup>17</sup> decision support,<sup>18</sup> and feedback.<sup>19</sup> For those who have graduated and are in practice, sentinel criteria (like CBC with or without WBC differential) might help identify those most likely to order excessively and help create practice quality improvement initiatives. New initiatives like Choosing Wisely<sup>20</sup> will provide further incentive to reduce inappropriate ordering. Regardless, as shown in our study and other studies,<sup>14</sup> the costs and potential cost savings, particularly over the broad population, are huge. Further research into practising physicians' preventive health screening habits nationally could help identify the scope and magnitude of overordering and the effects on the health care system and, more important, on patient care. This type of research is both lacking and needed.<sup>21</sup>

## Strengths and limitations

Strengths of this project included a survey response rate of 66%. Also, residents across multiple residency training programs in a variety of settings (rural and urban) helped make the results more generalizable. Residents could choose from a broad range of tests, including radiologic investigations, for multiple patient types. Limitations included the fact that survey answers might not reflect actual ordering practices. Respondents' comments showed that there was confusion as to how screening was defined, affecting tests ordered. Although a possible limitation, this indicates that further education on screening maneuvers versus diagnostic testing might be needed.

## Conclusion

Family medicine residents order appropriate tests for preventive health screening quite well, but they also order additional inappropriate tests that can affect not only patient care but also cost to the health care system. Templates did not reduce inappropriate ordering and likely do not follow screening recommendations. Clearly, residency programs, teachers, and preceptors need to provide better education, and likely examples, for residents and learners.

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### Contributors

All authors made substantial contributions to the study design, writing, and editing. **Dr Fung** conceived the study, drafted the survey, worked on ethics approval, distributed the survey, organized the study, analyzed results, and edited the draft. **Dr Schabert** edited the survey, worked on ethics approval, distributed the survey, analyzed results, and edited the draft. **Dr MacLean** edited the survey, worked on ethics, analyzed results, and edited the draft. **Dr Asrar** edited the survey, distributed the survey, analyzed results, and edited the draft. **Dr Khory** edited the survey, distributed the survey, analyzed results, and edited the draft. **Mr Vandermeer** analyzed the results and edited the draft. **Dr Allan** drafted the survey, worked on ethics approval, organized the study, analyzed results, and wrote the first draft.

### Competing interests

None declared

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