

Electronic Consultation Between Primary Care Providers and Radiologists

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Keywords: access to care, eConsult, primary care provider, resource utilization

doi.org/10.2214/AJR.19.22270

Received September 5, 2019; accepted after revision February 7, 2020.

Presented at the 2018 ARRS Annual Meeting in Washington, DC, and the 2018 Canadian Association of Radiologists annual meeting, Montreal, QC, Canada.

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AJR 2020; 215:929–933

ISSN-L 0361–803X/20/2154–929

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OBJECTIVE. The purpose of this study was to assess the use of an electronic consultation platform to connect primary care providers and radiologists and provide opportunities for valuable consultation regarding diagnostic imaging in patients, as well as to identify opportunities for targeted education surrounding high-yield radiology topics.

MATERIALS AND METHODS. A retrospective review was performed of consultations conducted using the electronic platform from September 2012 to January 2017. Consultations were classified by subspecialty (neuroradiology, thoracic, abdominal, musculoskeletal, or pediatric radiology), question type (workup, surveillance, education, specialist referral query, discharge, or other), anatomy, and pathology. Feedback surveys were completed by primary care providers after each consultation to evaluate timeliness, value, and impact on patient care.

RESULTS. A total of 302 consultations were reviewed. Subspecialty breakdown was as follows: abdominal, 94/302 (31%); neuroradiology, 74/302 (25%); musculoskeletal, 61/302 (20%); thoracic, 56/302 (19%); and pediatric, 17/302 (6%). The majority of consultations pertained to patient workup (112/302 [37%]), surveillance of imaging findings (95/302 [31%]), and provider education (48/302 [16%]). Cystic lesions (38/302 [13%]), pain (24/302 [8%]), and bone lesions (21/302 [7%]) were the most queried conditions. Patient management was altered in 167 cases (55%), and unnecessary testing was avoided in 84 (28%). Providers rated the perceived value of the electronic consultation system as excellent in 227 cases (75%).

CONCLUSION. The electronic consultation system allowed primary care providers to easily consult with radiologists, was perceived as high value by primary care providers, resulted in altered patient management, and avoided unnecessary imaging tests. We identified follow-up imaging of cystic lesions and imaging workup of pain in patients as opportunities for continuing medical education for primary care providers.

Canada's publicly funded health care system consumed 11.5% of the annual gross domestic product in 2017; in particular, Can\$52.2 billion was spent providing health care to Ontario's 13.6 million inhabitants that year [1, 2]. Health care providers have an ethical obligation to provide the most up-to-date evidence-based care while ensuring economic use of resources, especially in diagnostic radiology. At The Ottawa Hospital, the mean wait time for nonurgent CT and MRI is 146 days as of 2019, highlighting room for improvement [3]. The unparalleled diagnostic information obtained from medical imaging and the large part it plays in guiding patient management have contributed to a surge in imaging requests [4]. In addition, incomplete knowledge translation by

specialists coupled with complex and continuously evolving guidelines may result in a lack of awareness of current best practice, leading to unnecessary imaging requests [5].

Unlike traditional specialist consultations, most radiology consultations do not result in radiologists interacting directly with the patient; however, access to expert opinion regarding workup and disease surveillance remains a critical part of a patient's care. The eConsult (Champlain BASE) electronic consultation platform was developed to provide a secure method for primary care providers (PCPs) to ask a specialist patient-specific questions supported by relevant clinical information [6, 7]. Previous studies have found that giving PCPs increased and easy access to specialist opinions via eConsult reduces unnecessary consultations, decreases wait

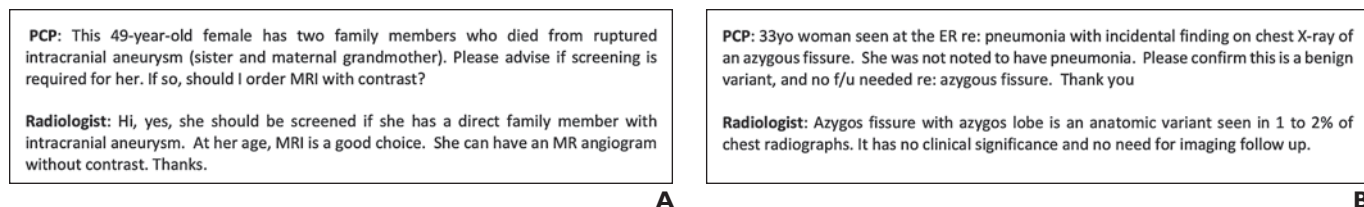


Fig. 1—Consultation interactions facilitated through eConsult platform (Champlain BASE).

A and B, Two examples of interactions between primary care physicians (PCPs) and radiologists illustrate use of software. yo = year-old, ER = emergency room, f/u = follow-up.

times, and results in more efficient use of resources [8, 9]. Providing this service via an online platform may also improve access to underserved rural PCPs and their patients. Figure 1 provides two examples of consultations accomplished using eConsult.

The primary goal of this study was to assess whether the eConsult platform was successful in connecting PCPs and radiologists and provided valuable consultation regarding patient diagnostic imaging. Our secondary goal was to analyze the PCP queries and identify possible knowledge gaps that could provide an opportunity for targeted education surrounding high-yield radiology topics.

Materials and Methods

The study was approved by the Ottawa Health Science Network research ethics board. All consultant radiologists were board certified or had academic licenses and had at least 10 years of experience in independent practice. PCPs accessed the eConsult service using a secure, personal log-in process. Within the platform, they could enter their question and attach relevant documentation, such as laboratory values and prior imaging reports. The PCP selected a radiology subspecialty from a drop-down menu that included neuroradiology, abdominal, thoracic, musculoskeletal, or pediatric radiology. The participating radiologist was then notified of the eConsult, viewed it, and confirmed whether enough clinical information was available to provide a useful response, which the PCP could expect within 7 days. Once the eConsult had been answered, the PCP was notified and could accept the radiologist's suggestion or continue the discussion with the radiologist. The PCP then completed a mandatory survey to provide insight into the perceived usefulness of the platform and the impact on the patient's care and was invited to provide feedback about the service and response received (Fig. 2A). The radiologist self-reported the time required to complete the eConsult and was reimbursed according to a prorated hourly rate.

This study was conducted as a retrospective review. All eConsults between PCPs and radiologists from September 2012 to January 2017 within our local health integration network were analyzed.

Completed eConsults were classified according to six question types (workup, surveillance, education, specialist referral query, discharge, and other) and anatomy (Table 1). The anatomic classification was further subclassified by the most common conditions. Content classifications and subclassifications were determined by author consensus. One author classified and coded all of the eConsults; two other authors classified 15% of the eConsults to confirm accuracy. Any disagreements were discussed and clarified. All data were exported to Excel (version 15.2, Microsoft) for analysis.

Results

Of the 20,678 eConsults completed through the service to all participating specialists during the study period, 307 (1.48%) were sent to radiologists and were therefore analyzed. Five eConsults were excluded from analysis because the clinical information provided was not sufficient to allow accurate classification. Most eConsults were submitted by physicians (286/302 [95%]), with nurse practitioners completing a small portion (16/302 [5%]). Overall, 135 PCPs submitted at least one eConsult during the study period. The median time for a PCP to complete an eConsult was 10 minutes (range, 5–35 minutes), although data on time to complete were not recorded until after the start of our data collection period and were therefore only available for 229 eConsults. The majority of eConsult responses (108/302 [36%]) were completed by radiologists in 10 minutes or less.

Subspecialties that eConsults involved were as follows: abdominal radiology (94/302 [31%]), neuroradiology (74/302 [25%]), musculoskeletal radiology (61/302 [20%]), thoracic radiology (56/302 [19%]), and pediatric radiology (17/302 [6%]). The most common question types pertained to workup (112/302 [37%]), surveillance (95/302 [31%]), and education (48/302 [16%]). With regard to anatomic subclassification, eConsults most often pertained to the brain (47/302 [16%]), lungs (30/302 [10%]), spine (29/302 [10%]), and liver (27/302 [9%]) (Fig. 3). Further subclassification revealed the most common conditions were cystic lesions (38/302 [13%]), pain (24/302 [8%]), bone lesions (21/302 [7%]), and nodules (18/302 [6%]) (Fig. 4).

Two questions on the mandatory survey captured the impact of the eConsult on the care of the patient (Fig. 2A). Question 1 (Q1) asked PCPs to describe the outcome of the eConsult for their patient: 115 of 302 eConsults (38%) confirmed a course of action that the PCP already had in mind, whereas 167 (55%) resulted in PCPs pursuing a new or additional course of action based on the advice they received. Q2 centered around the need for a traditional face-to-face referral or, in this case, a referral for a medical imaging test. After eConsults, referrals that were originally contemplated were avoided at this stage of the patient's care in 84 of 302 cases (28%), and referrals originally contemplated remained necessary in 76 cases (25%).

TABLE 1: Breakdown of Queries by Anatomic Classification

Subspecialty	Anatomic Classification
Abdominal	Adnexa, appendix, biliary system, bladder, kidney, large bowel, liver, lymphadenopathy, mesentery, pancreas, prostate, rectum, small bowel, spleen, stomach, testes, uterus
Musculoskeletal	Bone density, feet or ankles, hands or wrists, hips, knees, long bones, muscles, pelvis, ribs, shoulders
Neuroradiology	Auditory system, brain, neck, peripheral nerves, skull, spinal cord, spine, vision
Thoracic	Breast, esophagus, heart, lungs, thyroid, vascular system

Note—If the subject of an eConsult (Champlain BASE) did not fit into one of the listed anatomic classifications, it was classified as "other."

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Q3 and Q4 revealed that PCPs highly valued the advice received. On a 5-point scale, the overall value of the eConsult was rated as excellent for the patient in 231 of 302 cases (76%) and as excellent for PCPs in 227 cases (75%). Figure 2B shows the overall responses for Q1–Q4. The last question in the survey invited PCPs to provide additional comments. Selected responses include “avoided repeating further imaging and radiation exposure

to the patient, so this was great”; “that was extraordinarily fast and helpful advice from MSK radiology, with a clear plan to follow”; “information provided will be useful for other clients in addition to this one”; and “extremely prompt and helpful, in this case definitely changed my course of management.” Although few responses were negative, one PCP commented, “by the time we got the reply, the patient went to the ER, had blood

work and CT, was diagnosed with multiple myeloma and was admitted for treatment.”

Discussion

The eConsult platform connects PCPs and radiologists to expedite patient care and provide improved access to expert consultation while promoting economic resource use. To our knowledge, our study is the first to describe the use of eConsult for radiolo-

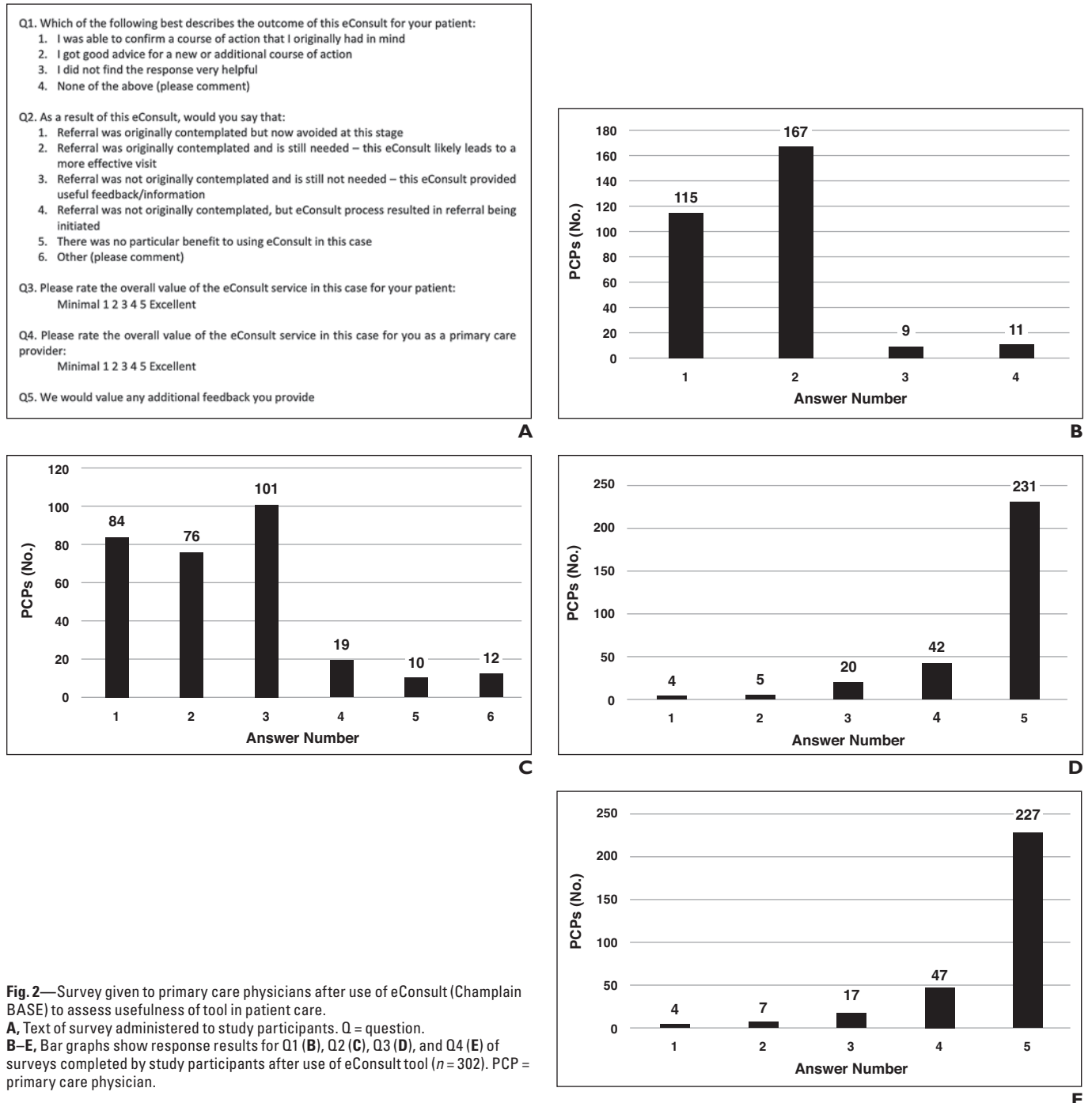


Fig. 2—Survey given to primary care physicians after use of eConsult (Champlain BASE) to assess usefulness of tool in patient care. **A**, Text of survey administered to study participants. Q = question. **B–E**, Bar graphs show response results for Q1 (**B**), Q2 (**C**), Q3 (**D**), and Q4 (**E**) of surveys completed by study participants after use of eConsult tool ($n = 302$). PCP = primary care physician.

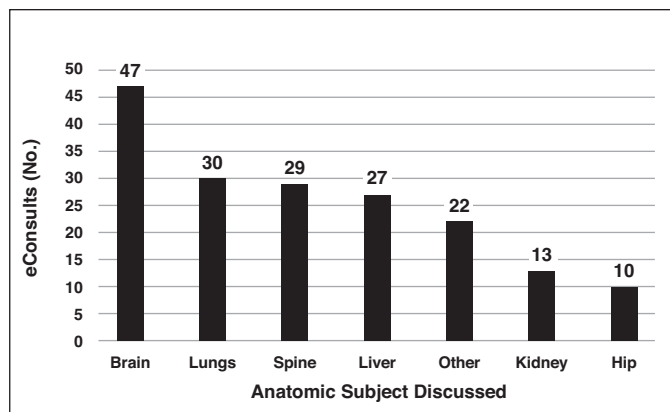


Fig. 3—Bar graph shows breakdown of interactions between primary care physicians and radiologists using eConsult software (Champlain BASE) by most common anatomic subject discussed.

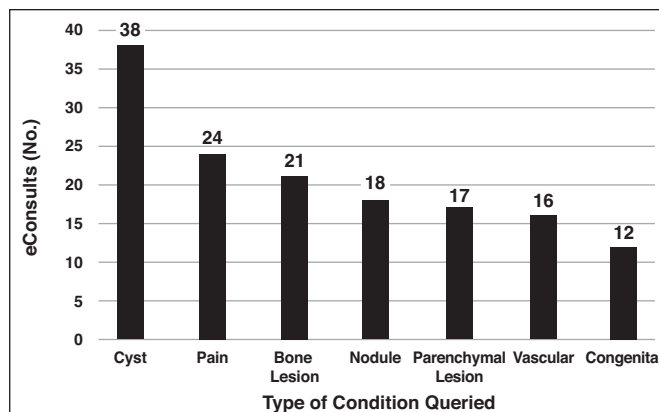


Fig. 4—Bar graph shows breakdown of interactions between primary care physicians and radiologists using eConsult software (Champlain BASE) by most commonly queried type of condition.

gy in Canada, and studies evaluating a similar radiology consultation system have not been conducted. Although abdominal imaging had the highest number of eConsults, the numbers among all of the radiologic subspecialties were comparable with the exception of pediatric radiology. The lower demand for this subspecialty is likely multifactorial and may relate to lower use of CT and MRI given their complicating factors (radiation exposure and anesthesia, respectively). This result may also stem from lower rates of detection of incidentalomas, indeterminate premalignant findings, and age-related degenerative processes. Our results suggest that PCPs access the platform for all adult radiologic subspecialties equally and that they are not uncomfortable with the medical imaging applications for any one subspecialty.

Questions pertaining to patient workup were the most common, accounting for just over one-third of queries. Given rapid advances in medical imaging and the wide variety of imaging modalities and protocols available, our results highlight the integral role that radiologists play in advising PCPs on the most appropriate imaging test to perform. By providing easy access to expert opinion, we bolster the view that radiologists are useful members of patients' care teams who offer input that alters patient care in over half of cases. Our results also revealed that eConsults prevented costly and unnecessary imaging in over a quarter of cases. This is even more important in underserved areas where patients may require transfer to a larger center to access imaging tests. Allowing PCPs to connect with radiologists through this online platform promotes a team-based

and patient-centered approach. Although the overall number of imaging studies that were avoided is low, the true number may be underestimated because PCPs can apply similar past eConsults to future clinical decision making. In addition, eConsult queries to the radiology service made up only a small percentage of the total eConsults submitted. As awareness of the eConsult service continues to grow and reach more PCPs in the community, we anticipate that the number of radiology eConsults will also continue to grow, and the number of imaging studies avoided will increase accordingly.

Although the eConsult service is available free of charge to users, there are costs for providing the service (including operations, support, and specialist remuneration), which are covered by the Ministry of Health. However, prior analysis has shown that eConsult provides an overall cost savings of Can\$11 per case across all specialties, including radiology, even after accounting for the cost of providing the service [10].

Given that the eConsult platform is aimed at helping PCPs and patients, evaluation of their experience is critical to providing a viable long-term solution for connecting with specialist physicians. In this study, results pertaining to perceived value were overwhelmingly positive, with three-quarters of PCPs rating the value of the service for both themselves and their patients as excellent; similar positive results were seen in the study by Shehata et al. [8] Although comments from PCPs were exceedingly positive, the negative comment noted earlier suggests that the eConsult platform may not be suitable for acute care scenarios.

PCP inquiries about surveillance of previously identified abnormalities were the subject of approximately one-third of eConsults, with the majority involving findings in the abdomen, neurologic system, or chest. Cystic lesions, such as liver or kidney cysts, were the most common subjects of queries pertaining to surveillance. Surveillance of nodules occurring in the lungs or thyroid was also a common question that was asked in 13 eConsults. Frequently, diagnostic imaging tests result in new findings for which a recommended follow-up timeline or modality is not provided in the radiologist's report, leaving this to the judgment of the referring physician. Given that a large part of radiologists' work involves interpreting images and making recommendations on patient care, our study suggests that they need to make best-evidence follow-up suggestions a priority. This is especially important because the rate of incidental findings ranges from 15% to 37% on CT, for example [11, 12]. As always, practices differ among radiologists, and many choose not to report incidental findings, such as a simple kidney cyst, that appear benign and require no follow-up. Others prefer to report these findings because the abnormality is present on the image. Within reason, both practices are safe and effective for patients. However, if a radiologist chooses to include an incidental and benign finding in the report, then care recommendations should be clearly stated. An advantage of eConsult is that the platform affords an avenue for data collection and analysis, which was a secondary objective of this study. By identifying trends in the eConsult data, we can provide insight from radiologists into

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useful topics for continuing medical education (CME) for PCPs. This study identified the surveillance of nodules and cysts and workup of patients reporting pain as topics that PCPs may find highly valuable for targeted knowledge translation. Through targeted CME, we hope to further increase the number of imaging studies that are avoided, although the absolute end effect may be difficult to accurately capture.

Our study is not without limitations. The eConsult platform is a novel idea in our health network, and other services that PCPs could compare with eConsult are limited. Our study is also limited by sampling bias. Although most PCPs saw high value in the platform, we do not currently have a way to track those who choose not to use the service and may judge it to be of low value.

Conclusion

The eConsult platform provides PCPs with easy access to expert opinion by radiologists and promotes collaboration between physicians to improve patient care. As a result of eConsult, patient care was altered and unnecessary imaging tests were avoided, resulting in

more efficient resource use. It may be helpful for radiologists to alter their reporting style to include clear follow-up guidelines for incidental findings, and that PCPs may benefit from CME on imaging of cystic lesions and use of imaging in the workup of a patient's pain.

References

1. Canadian Institute for Health Information. National health expenditure trends, 1975 to 2017. Ottawa, ON, Canada: Canadian Institute for Health Information, 2017
2. Ontario Ministry of Finance. 2017 Ontario budget. www.fin.gov.on.ca/en/budget/ontariobudgets/2017/budget2017.pdf. Accessed February 5, 2019
3. Government of Ontario website. Wait times for diagnostic imaging. www.ontario.ca/page/wait-times-diagnostic-imaging. Accessed May 1, 2019
4. Midia M, Oedra D, Haider E, Shuster A, Muir J. Choosing wisely Canada and diagnostic imaging: What level of evidence supports the recommendations? *Can Assoc Radiol J* 2017; 68:359–367
5. Fischer F, Lange K, Klose K, Greiner W, Kraemer A. Barriers and strategies in guideline implementation: a scoping review. *Healthcare (Basel)* 2016; 4:36
6. Liddy C, Rowan MS, Afkham A, Maranger J, Keely E. Building access to specialist care

- through e-consultation. *Open Med* 2013; 7:e1–e8
7. Liddy C, Maranger J, Afkham A, Keely E. Ten steps to establishing an e-consultation service to improve access to specialist care. *Telemed J E Health* 2013; 19:982–990
8. Shehata F, Posner G, Afkham A, Liddy C, Keely E. Evaluation of an electronic consultation service in obstetrics and gynecology in Ontario. *Obstet Gynecol* 2016; 127:1033–1038
9. Bradi AC, Sitwell L, Liddy C, Afkham A, Keely E. Ask a neurologist: what primary care providers ask, and reducing referrals through eConsults. *Neurol Clin Pract* 2018; 8:186–191
10. Liddy C, Drosinis P, Armstrong CD, McKellips F, Afkham A, Keely E. What are the cost savings associated with providing access to specialist care through the Champlain BASE eConsult service? *BMJ Open* 2016; 6:e010920
11. Lumbreras B, González-Alvarez I, Lorente MF, Calbo J, Aranaz J, Hernández-Aguado I. Unexpected findings at imaging: predicting frequency in various types of studies. *Eur J Radiol* 2010; 74:269–274
12. Furtado CD, Aguirre DA, Sirlin CB, et al. Whole-body CT screening: spectrum of findings and recommendations in 1192 patients. *Radiology* 2005; 237:385–394