Test Result Management Practices of Canadian Internal Medicine Physicians and Trainees

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BACKGROUND: Missed test results are a cause of medical error. Few studies have explored test result management in the inpatient setting.

OBJECTIVE: To examine test result management practices of general internal medicine providers in the inpatient setting, examine satisfaction with practices, and quantify self-reported delays in result follow-up.

DESIGN: Cross-sectional survey.

PARTICIPANTS: General internal medicine attending physicians and trainees (residents and medical students) at three Canadian teaching hospitals.

MAIN MEASURES: Methods used to track test results; satisfaction with these methods; personal encounters with results respondents "wish they had known about sooner."

KEY RESULTS: We received surveys from 33/51 attendings and 99/108 trainees (response rate 83%). Only 40.9% of respondents kept a record of all tests they order, and 50.0% had a system to ensure ordered tests were completed. Methods for tracking test results included typed team sign-out lists (40.7%), electronic health record (EHR) functionality (e.g., the electronic "inbox") (38.9%), and personal written or typed lists (14.8%). Almost all trainees (97.9%) and attendings (81.2%) reported encountering at least one test result they "wish they had known about sooner" in the past 2 months ($p = 0.001$). A higher percentage of attendings kept a record of tests pending at hospital discharge compared to trainees (75.0% vs. 35.7%, $p < 0.001$), used EHR functionality to track tests (71.4% vs. 27.5%, $p = 0.004$), and reported higher satisfaction with result management (42.4% vs. 12.1% satisfied or very satisfied, $p < 0.001$).

CONCLUSIONS: Canadian physicians report an array of problems managing test results in the inpatient setting. In the context of prior studies from the outpatient setting, our study suggests a need to develop interventions to prevent missed results and avoid potential patient harms.

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INTRODUCTION

Diagnostic tests are critical for modern medical practice. However, a test is only useful if the results are reviewed and translated into action. There is growing appreciation that a significant percentage of tests are simply lost to follow-up.[1–6] Breakdowns can occur at any stage of the testing process, but recognition of finalized results is particularly vulnerable to error,[7, 8] especially during care transitions such as for tests pending at hospital discharge (TPADs).[9–12] In 2004, Poon and colleagues found that only 52% of US outpatient internists kept a record of ordered tests, 32% had a system to detect if a patient failed to receive a test, and 59% were not satisfied with their test result management.[13] In 2015, Litchfield et al. found 40% of primary care practices in the UK required patients to phone for abnormal test results and 80% lacked a failsafe to ensure results were received.[14] Other studies from the US and UK have also described challenges managing test results;[15–19] however, there is little data focusing on inpatient care and, virtually, no literature on test result management in Canada. The lack of investigation in Canada is problematic because the Canadian healthcare system differs from the US and UK with respect to funding and organization and lags far behind most other developed countries with respect to electronic health record (EHR) implementation.[20–22] Moreover, integrated healthcare delivery systems are underdeveloped,[23] resulting in fragmentation and discontinuity when patients transition from hospital to outpatient settings.

The objectives of our study were to (1) explore test result management practices of Canadian general internal medicine (GIM) faculty and trainees providing inpatient care and (2) determine satisfaction with current practices and frequency of self-reported delays in test result follow-up. We hypothesized that problems identified in older studies would persist in current-day Canada.

METHODS

Setting and Participants

We conducted a cross-sectional survey at three University of Toronto teaching hospitals between November 2016 and October 2017. Study sites were Toronto General Hospital (TGH), Toronto Western Hospital (TWH), and Mount Sinai Hospital (MSH). All are tertiary/quaternary care hospitals located in downtown Toronto with most GIM admissions (> 90%) coming as referrals through the emergency department. Participants were either trainees (medical students and residents) working on GIM inpatient services at the time of survey or staff physicians (aka, attendings) who attend on inpatient GIM teaching services. Attendings typically perform > 90% of their clinical work at their base hospital; trainees rotate between hospitals and perform approximately 75% of their clinical work at their base hospital which changes with each academic year.

TGH and TWH use a common EHR system (electronic patient record (EPR); QuadraMed CPR, Herndon, VA); MSH uses Power Chart (Cerner Corp, Kansas City, MO). Both EHRs utilize computer physician order entry and display completed test results. The EPR system includes an inbox function for result review and sign-off. The attending's inbox automatically reports all new results for inpatients admitted under their name; trainees must take an additional step of assigning themselves to each patient to receive results. There is no inbox function at MSH. Both sites use stand-alone typed electronic sign-out lists that must be manually populated with patient information, active issues, and therapeutic plan used for physician handover.

Survey Tool

We developed a survey (Online Appendix) building upon prior studies of test result management.[10, 13, 15, 19] Questions were taken verbatim or adapted as needed to suit our inpatient setting.

The first section collected demographics including age, sex, and level of training. The second section focused on self-reported test ordering volumes which are not germane to the current analysis but may be published in a follow-up manuscript.

The third section focused on individuals' test result management practices: we asked respondents "do you keep a record of the tests you have ordered?," "do you have a system to detect if a patient fails to obtain a test you have ordered?," and "do you keep a record of patients with pending test results at the time of hospital discharge?," all with yes/no responses. Participants described their methods using free-text responses. We also asked the number of times in the past 2 months respondents encountered a result they "wish they had known about sooner." We asked about satisfaction with test management systems, concern that ordered tests may not be performed, concern that abnormal results may "fall through the cracks," and frequency of disclosure and documentation of normal and abnormal test results. These questions used five-point Likert-type responses from 1 representing a negative response (e.g., not at all confident, not important) to 5 representing a positive response (e.g., very confident, very important). We asked respondents for their confidence in "follow-up of clinically significant tests/investigations that are pending at hospital discharge," again with a five-point Likert-type response. We asked respondents who was responsible for follow-up of studies pending at discharge (options included resident, attending physician, outpatient provider, or patient). Respondents could select multiple options but were also asked to identify the single most responsible individual.

Section 4 focused on education. Trainees were asked "how often do you receive feedback?" on appropriateness of ordered tests, timeliness of test result follow-up, and disclosure of test results to patients. Attendings were asked "how often do you provide feedback?" on the same topics. We pilot tested the survey to refine clarity and content prior to distribution.

Survey Administration

We distributed surveys between November 2016 and October 2017. Trainees completed the surveys during noon teaching conferences. Attending physicians were solicited through email and staff meetings. All surveys were completed anonymously. We calculated that a sample size of 125 completed surveys would provide us with 80% power to detect a 0.5 difference in Likert-type responses for attendings compared to trainees.

Statistical Analysis

We used basic descriptive statistics for respondent demographics. We compared responses of attendings and trainees using chi-square statistic and *t* test for categorical and continuous responses with p values < 0.05 judged statistically significant. Likert-type responses were dichotomized into positive (4 or 5) or neutral/negative (1 to 3). We conducted stratified analyses to evaluate result management by respondent sex, level of training (medical students vs. residents), and health system (TGH and TWH vs. MSH).

We used logistic regression models to explore the association between self-reported satisfaction (positive Likert 4–5 vs. neutral/negative Likert 1–3) with personal test result management practices and respondent characteristics (attending vs. trainee; male vs. female).

Free-text responses (Online Appendix, Survey Tool, Section 3, Questions 1, 2, and 8) were analyzed using qualitative methods. We developed a preliminary coding scheme based upon test result management strategies that have been cited in the literature; themes were then modified to reflect and encompass the methods reported by respondents. A sample of 33% of surveys was reviewed in duplicate by two study authors to ensure that codes were clear.

Statistical analyses were performed using Microsoft Excel 2013 (Microsoft Corp., Redmond, WA) and R statistical software (version 3.4.0; R Core Team, Vienna, Austria). Institutional review board approval was obtained at each hospital site and the University of Toronto.

RESULTS

Our overall response rate was 83.0% (132/159) [91.7% for trainees (99/108) and 64.7% for attendings (33/51)] ($p < 0.001$). The mean age of attendings was 42.5 years (37.5% women), and trainees was 27.3 years (43.4% women).

Test Result Management Practices

40.9% of respondents (54/132) reported maintaining a record of tests that they order, and 50.0% (66/132) reported having a system to track if patients fail to receive ordered tests. 19.7% (26/132) were satisfied with their result management systems, while 40.2% (53/132) were concerned that test results may "fall through the cracks." Comparison of attendings and trainees revealed a number of differences (Table 1).

46.2% of all respondents (60/130) reported keeping a record of TPADs (Table 2). 58.6% (75/128) felt they were aware of 75% or more of all TPADs. Only 33.3% (42/126) reported following up on all clinically significant TPADs, and only 3.9% (5/129) reported listing all clinically significant TPADs in the discharge summary. Both attendings and trainees expressed that the primary person responsible for follow up of TPADs was the attending (Table 2), but that trainees, patients, and the outpatient physician bore some responsibility as well.

Delays in Test Result Follow-up

93.7% of respondents (119/127) reported encountering at least one test result that they "wish they had known about sooner" in the past 2 months, and 29.1% (37/127) reported encountered 5 or more (Fig. 1). Attendings were less likely than trainees to report at least one result they wished they had known about sooner (81.3 vs. 97.9%, $p = 0.001$).

Self-Described Methods for Managing Test Results

Methods used to manage test results are described in Table 3. Common methods for tracking ordered tests included using the team sign-out list (40.7%, 22/54), the EHR (38.9%, 21/54), and a personal handwritten list (14.8%, 8/54) (respondents could indicate multiple methods). Only 18.5% (10/54) specifically mention using the inbox function at UHN to track ordered tests. Methods differed between attendings and trainees (Table 3).

Among respondents who reported keeping a record of TPADs, 30.0% (18/60) used a hand-written or electronic list, 26.7% (16/60) used EHR functionality, 20.0% (12/60) used the team sign-out list, 5.0% (3/60) used a follow-up appointment, and 3.3% (2/60) used the discharge summary. Trainees were more likely to report using the sign-out list, while attendings were more likely to report using EHR functions such as the inbox (Table 3).

Determinants of Physician Satisfaction

Univariate regression analyses suggested increased satisfaction with test result management strategies among attending physicians compared to trainees (odds ratio (OR) 1.43, 95% CI 1.18–1.83, $p < 0.001$), for respondents who reported having a system to detect if a patient fails to receive an ordered test compared to respondents with no system (OR 1.27, 95% CI 1.09–1.53, $p = 0.002$) and those who used the inbox for tracking tests compared to those who did not use the inbox (OR 1.50, 95% CI 1.11–2.31, $p = 0.005$).

Education on Test Result Management

Attendings were much more likely to report teaching trainees about test ordering practices, test result follow-up, and result disclosure than the trainees were to report receiving such teaching (Fig. 2).

Table 1 Attending and Trainee Test Result Management Practices

	Attendings	Trainees	*p* value
I keep a record of tests I have ordered, number (%)* answering Yes (Online Appendix, survey question PIII-Q1)	14 (42.4)	40 (40.4)	0.84
I have a system to detect if a patient fails to obtain test I have ordered, number (%) answering Yes (PIII-Q2)	34 (57.6)	47 (47.5)	0.32
I am satisfied or very satisfied† with my system for managing test results, number (%) (PIII-Q3)	14 (42.4)	12 (12.1)	< 0.001
I am concerned or very concerned† that a test I have ordered may not be performed, number (%) (PIII-Q17)	12 (36.4)	21 (21.2)	0.08
I am concerned or very concerned† that an abnormal test result might "fall through the cracks", number (%) (PIII-Q18)	18 (54.5)	35 (35.4)	0.05
I consider it important or very important† to notify patients of normal test results, number (%) (PIII-Q11)	15 (46.9)	32 (32.3)	0.14
I consider it important or very important† to notify patients of abnormal test results, number (%) (PIII-Q12)	29 (87.9)	86 (86.9)	0.88
I frequently or always† document notifying patients of normal test results, number (%) (PIII-Q14)	2 (6.1)	9 (9.2)	0.58
I frequently or always† document notifying patients of abnormal test results, number (%) (PIII-Q15)	17 (51.5)	41 (41.8)	0.47
I spend X% of my work day managing/reviewing inpatient test results, (%) (PIII-Q16)	26.4	43.3	< 0.001

**Percentage (%) is reported based on question-specific response rate*
†Response corresponds to 4 or 5 on a 5-point Likert-type scale

Table 2 Attending and Trainee Test Result Management Practices at Transitions of Care

	Attendings	Trainees	*p* value
I keep a record of patients with pending test results at hospital discharge, number (%)* answering Yes (Online Appendix, survey question PIII-Q8)	24 (75.0)	35 (35.7)	< 0.001
I am aware of 75% or more† of tests that are pending at hospital discharge, number (%) (PIII-Q6)	21 (65.6)	54 (56.3)	0.35
I list/mention all clinically significant‡ pending test results in the discharge summary, number (%) answering 100% (PIII-Q7)	1 (3.1)	4 (4.1)	0.80
I am confident or very confident† that I follow-up on tests with clinically significant† results which are pending at hospital discharge, number (%) (PIII-Q10)	22 (68.8)	20 (21.3)	< 0.001
I almost always or always† outline tests with pending results to colleague when handing over patient care (e.g., when leaving an inpatient service), number (%) (PIII-Q4)	21 (63.6)	64 (64.6)	0.92
Who is responsible for follow-up of pending tests at hospital discharge (select all that apply), number (%) (PIII-Q9a)			
1. Resident/trainee	6 (18.2)	46 (46.5)	0.004
2. Attending physician	32 (97.0)	85 (85.9)	0.56
3. Receiving provider	10 (30.3)	60 (60.6)	0.04
4. Patient	5 (15.2)	17 (17.2)	0.81
Who is most responsible for follow-up of pending tests at hospital discharge (select one), number (%) (PIII-Q9b)			
1. Resident/trainee	0 (0.0)	9 (10.6)	0.07
2. Attending physician	29 (93.5)	61 (71.8)	0.24
3. Receiving provider	2 (6.5)	13 (15.3)	0.24
4. Patient	0 (0.0)	2 (2.4)	0.39

**Percentage is based on question-specific response rate*
†Response corresponds to 4 or 5 on a 5-point Likert-type scale
‡Clinically significant = results which would be considered important to the patient and/or impact the clinical course or treatment plan

Subgroup Analysis

We found medical students felt that it was important to notify patients of normal test results more often than residents (52 vs. 24%, $p = 0.008$), and medical students were more likely to self-report documenting having notified patients about normal test results (21 vs. 4%, $p = 0.01$). There were no other significant differences by level of training or for men compared to women.

In comparisons across sites, respondents at TGH/TWH were more likely to answer *yes* to having a system for detecting if a patient fails to obtain a test when compared to MSH (58.4 vs. 38.2%, $p = 0.02$). Respondents from TGH/TWH also had higher levels of satisfaction with test result management (26.0 vs. 10.9%, $p = 0.03$) (Online Appendix).

DISCUSSION

In a survey of Canadian internal medicine physicians and trainees practicing in the inpatient setting, respondents reported multiple problems with test result management. Problems included delays in recognition of abnormal results, inconsistent utilization of existing EHR test result management tools, dissatisfaction with personal methods for managing results, and lack of agreement for who is responsible for follow-up of TPADs. A number of our findings warrant discussion.

First, it is important to acknowledge the documented harms of missed test results including untreated infections,[9, 24] missed malignancies,[5, 25, 26] missed aortic aneurysms,[27] missed osteoporosis,[28] and other abnormalities.[29] Much of the existing literature is becoming dated and comes from the US outpatient setting. Our results expand on prior studies by providing contemporary data from the inpatient setting in Canada.

While we are unaware of any longitudinal studies looking at changes in missed results over time, comparing our work with older studies offers a starting point. Specifically, 94% of respondents in our study reported encountering at least one result they "wish they had known about sooner" in the past 2 months and 29% reported encountering 5 or more. By comparison, a 2004 survey of US outpatient internists (using the identical question) found that 83% had encountered one delayed test result in the previous 2 months and 18% had encountered 5 or more.[13] Our results suggest that delayed recognition of abnormal test results remains a problem.

Second, we found that attendings and trainees were not using functions in our EHR designed to facilitate test result management. The study hospitals have EHRs with user interfaces for tracking ordered tests, and two sites (TGH

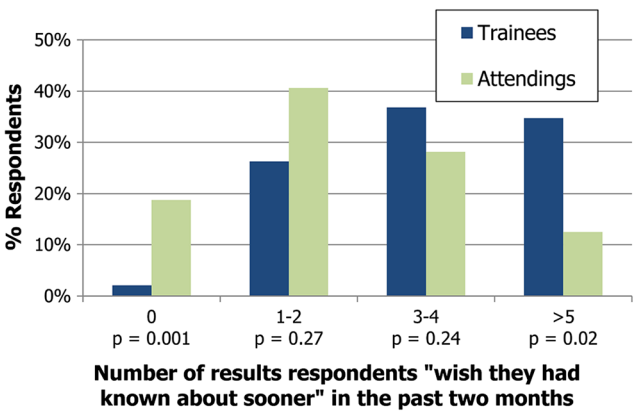

Figure 1 Self-reported delays in test result follow-up.

Table 3 Methods Used to Track Ordered Tests for Hospitalized Patients and at Discharge

Survey task	Response themes	Representative quotes	Attendings using this method, number (%)*	Trainees using this method, number (%)*	*p* value
Describe how you keep a record of the tests you have ordered. (Online Appendix, survey question PIII-Q1)	Team sign-out list	"On the sign-out sheet" "Sign-out tool"	0 (0.0)	22 (55.0)	< 0.001
	EHR functionality	"Inbox function" "Check the '18 button' [combined results on EPR] to see if they have been collected"	10 (71.4)	11 (27.5)	0.004
	Personal list	"Track tests on my patient cards" "An informal list of results to follow-up on"	4 (28.6)	4 (10.0)	0.09
	Other	–	0 (0.0)	0 (0.0)	–
	Not specified	–	1 (7.1)	7 (17.5)	0.35
Describe the methods you use to ensure a test which you have ordered is completed. (PIII-Q2)	Team sign-out list	"Via sign-out, but not always inclusive of all tests" "EPR + Sign-out tools"	3 (15.8)	9 (19.1)	0.75
	EHR functionality	"Order status on EPR" "Check 'combined results' tab on all patients" "EPR Inbox"	9 (47.4)	19 (40.4)	0.61
	Personal list	"Keep a list of pending investigations on each patient" "Patient cards"	4 (21.1)	4 (8.5)	0.16
	Other	"Check results before morning rounds" "Create a reminder on Outlook [email]"	5 (26.3)	14 (29.8)	0.78
	Not specified	–	0 (0.0)	6 (12.8)	0.10
Describe how you keep a record of tests with pending results at discharge. (PIII-Q8)	Team sign-out list	"Leave patients on our sign-out with indication of when tests is pending"	2 (8.3)	10 (28.6)	0.06
	EHR functionality	"I have a personalized patient list in EHR to remind me" "Inbox"	13 (54.2)	3 (8.6)	< 0.001
	Personal list	"Reminders on phone" "Sticky notes on my computer screen"	8 (33.3)	10 (28.6)	0.70
	Discharge summary	"Discharge summary, communication with GP"	0 (0.0)	2 (5.7)	0.23
	Follow-up appointment	"Follow-up clinic referral" "I arrange follow-up with myself after discharge"	1 (4.2)	2 (5.7)	0.79

**Percent of those who indicated using this method reported as a number of respondents indicating a given method divided by the number of respondents answering yes to the question PIII-Q1/Q3/Q8. Respondents may have used more than one method; hence, results do not add up to 100%*

and TWH) have an inbox for physician review/sign-off on results. Despite these tools, 59% of respondents reported that they lacked a method to track tests from order entry to completion, with 16% of all survey respondents using the EHR and 8% mentioning the inbox. Our findings are consistent with a 2015 UK study that found that primary care practices did not use features of the EHR specifically designed to make test result management easier.[14] It is important to consider that EHR adoption in Canada has been low when compared to other developed countries.[30] Future investments will need to consider the socio-technical aspects of EHR adoption.[31] If physicians are not taught how EHR functions can improve efficiency and patient safety, it seems logical that physicians would not use these functions and this seems to be supported by our survey.

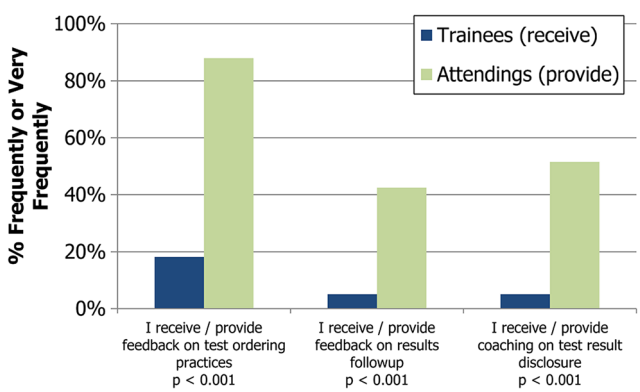

Figure 2 Self-reported frequency of education related to test result management.

Our finding that only 20% of respondents were satisfied with their test result management practices (80% of Canadian internal medicine physicians are satisfied with their professional life)[32] provides further evidence that there is a problem with test result management. This dissatisfaction is consistent with older outpatient US studies and provides the first evidence we know of extending these results to Canadian inpatient care.[13]

Third, comparison of responses from attendings and trainees warrants comment. We found lower satisfaction and higher

self-reported encounters with delayed result recognition for trainees compared to attendings. It is possible that these results reflect improvements in performance with experience; alternatively, it is possible that attendings have a false sense of confidence. Empirical studies are needed. We also found it interesting that 97% of attendings and 86% of trainees felt the attending was most responsible for TPAD follow-up. Conversely, we view it as troubling that few respondents think trainees should be responsible for follow-up of TPADs even though trainees enter the orders for the vast majority of tests in our hospitals. One could argue that it is inconsistent to allow trainees to order tests, but then absolve them from the responsibility of follow-up.[33] Interestingly, with less than 10% of trainees in our study reporting that they had received education on test result management (but 42% of attendings reporting that they teach on this topic), our study seems to highlight an opportunity to improve training at our institution.

Fourth, it is important to consider potential solutions to improve follow-up of test results. Most interventions studied in the outpatient setting have focused on health information technology and EHRs,[34–36] with mixed evidence in terms of effectiveness.[37, 38] Promising interventions for TPADs include enhanced discharge summaries that are auto-populated with test results that are both completed and pending, and notification systems that distribute email alerts when pending results become finalized.[39] There are many potential solutions that are largely unstudied. For example, healthcare teams could assign test result follow-up responsibilities to dedicated staff. Patient portals could be enhanced to empower patients to take an active role in checking their own results and notifying their healthcare team when questions arise.[40] Patient empowerment has proven effective in other care settings.[41, 42] Finally, it is important to consider the role of personal responsibility with respect to test result follow-up.[43] It may be reasonable to argue that the individual who orders the test should be expected to follow-up on the result.[44]

Our study has limitations that warrant mention. First, our study was conducted at three Toronto teaching hospitals and results should be generalized with care. Second, our study relies on self-report; future studies should use an alternative method such as medical record review or review of EHR audit logs to assess the magnitude of the problem of missed results. For example, when asking respondents about results they "wish they had known about sooner," we were not able to identify the type of result or why. Third, we lack quantitative data on the types of tests being ordered and missed. Finally, our study focused on inpatient internal medicine wards and it will be important to verify our results in other inpatient services.

In conclusion, we found that deficiencies in the test result management process identified more than a decade ago persist in contemporary Canadian inpatient teaching hospitals. While a number of promising solutions are emerging, rigorous evaluation and widespread implementation remain distant.

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