Author’s response to reviews

Title: Advancing Laboratory Medicine in Hospitals through Health Information Exchange: A Survey of Specialist Physicians in Canada

Authors:

Louis Raymond (louis.raymond@uqtr.ca)
Eric Maillet (eric.maillet@usherbrooke.ca)
Marie-Claude Trudel (marie-claude.trudel@hec.ca)
Josianne Marsan (josianne.marsan@sio.ulaval.ca)
Ana Ortiz de Guinea (ana.ortiz-de-guinea@hec.ca)
Guy Paré (guy.pare@hec.ca)

Version: 1 Date: 23 Dec 2019

Author’s response to reviews:

Response to editor and reviewers – manuscript MIDM-D-19-00379

Editor’s comments:

Based on these reports, and my own assessment as Editor, I am pleased to inform you that it is potentially acceptable for publication in BMC Medical Informatics and Decision Making, once you have carried out some essential revisions suggested by our reviewers.

We thank you for your positive assessment and for giving us a chance to revise and improve the overall quality of our manuscript.

Two reviewers raised concerns about the survey. In particular the design and the validation of the survey do not seem to be sufficiently described.

We took this comment very seriously and made the appropriate changes, as detailed below in our response to Reviewer 2’ and Reviewer 4’s comments on the Methods and Results sections of the paper.
Reviewer 1’s comments:

Thanks for the opportunity to review this work. Authors have used data from a larger study (a survey study conducted in the province of Quebec in Canada) to conduct descriptive analyses regarding the use of various health information exchange (HIE) systems by specialist providers. The primary conclusion is that there exists notable variability on which systems are used, and to what extent, based on certain provider characteristics such as place of practice (rural versus urban hospital).

Thank you very much for your positive introductory remarks.

One factor that was not addressed in this analysis was the potential for different needs by different types of providers. For instance, if providers in rural settings mostly provide primary to secondary care, and those in urban settings mostly provide tertiary care, the types of tests they order (and therefore look up in the HIE systems) may differ, and this could also impact their choice of systems they use, extent to which they use these systems, and their perception of these systems. Authors indirectly mention this limitation, but I believe mentioning it directly would be more appropriate.

In Quebec’s national healthcare system, all specialist physicians working in non-emergency hospital settings provide only secondary to tertiary care. We now mention this specifically, as follows: “Our sample is composed of 566 SPs providing secondary or tertiary care in hospital settings”. We agree with the Reviewer that respondents working in tertiary care settings might differ in their use of HIE systems for laboratory purposes from those working in secondary care settings. We thus now directly mention this in the limitations of the paper, as follows: “However, as the hospital’s size and location explained only a small percentage of variance in the extent of HIE systems use by SPs, other organizational characteristics and in particular the hospital establishment’s status (e.g. general/secondary care/ vs. specialized/tertiary care establishment, non-affiliated vs. university-affiliated establishment) should be accounted for in future research. The same could be said of user characteristics, where the SPs’ gender and medical experience should be complemented by other characteristics such as their HIE experience and medical specialty.”

Regarding the study sample: Authors mention that 44% of the respondents worked in small or medium-sized hospitals and 56% in large hospitals. Did the surveyed group not include any physicians who do not work in hospitals (such as those who exclusively work in ambulatory settings)?
All physicians who participated in the present study worked in hospital settings. This is now clarified in the manuscript. According to the SP professional union, only 8.4% of its members do not work in hospital settings.

Another related question: is each responded only affiliated with one hospital? Could there by specialists who work in two places (e.g. a rural and an urban hospital) and use a different system in each work setting? Could this have contributed to the number of respondents who mentioned they are using more than one system?

Some SPs may be affiliated with two or more hospitals. However, we asked respondents to indicate what their main work affiliation was and to describe their use of HIE systems in this setting. We clarified this in the revised version.

Finally, while this study indicates that "context" of care impacts the providers' use of HIE, it does not provide the readers with a strong set of tools to classify different contexts. Also, it seems like provider characteristics are not different across the three HIE use profiles identified through cluster analysis. I wonder if additional variables (such as provider specialty, academic status of the hospital, etc.) could be compared across these HIE profiles to generate more insight.

In attempting to characterize the context of HIE use in its three fundamental dimensions (organizational, user, IT artefactual), yet with parsimony, we limited the number of indicators used to assess each dimension by selecting those most often found in the empirical HIE literature. Thus, in the case of the organizational context, we choose the hospital’s size and location. We do concur with the Reviewer that other indicators (such as academic status of the hospital) could have been used to paint a fuller picture of this context, which is why we now mention this at the end of the paper as a limitation/avenue for future research. Please also refer to our response to the Reviewer’s 2nd comment below.

Other recommendations:

* In table 1, I would change the label of the last column to "Chi-squared statistic". Done.

* In table 2, I found the use of the bidirectional arrow confusing. I believe authors can use "&amp;" instead. Done.

* Regarding table 4, were the same questions asked for both LRV and iEHR? For instance, were the users of both technologies asked if the system allows them to make better clinical decisions? In its current format, table 4 does not allow comparing the two systems in terms of any of the reported variables. A comparison of systems would be nice, if possible.
We did not ask the same questions given the different nature and potential benefits of LRV and iEHR systems. Hence, a comparative analysis is not relevant here.

Reviewer 2’s comments:

This manuscript presents findings that are important to those with closely related research interests. It surveys specialist physicians’ use of health IT to access patient lab results. This comes as a follow-up of the authors’ previous publications in a related field on 'family physicians' and 'primary care' as presented in literature n° 24 & 40, but also a recent systematic review published in 2018 between others.

Thank you for your positive comment.

Background:

* p3, lines 8-12: contains references (n° 13, 14, 15) to rather old publications on the field of EHR adoption in the US. Given the impact of the HITECH acts (2009) and the 'meaningful use' regulations of EHR, those documents are likely to be obsolete. The authors should use more recent publications in this domain and update that section.

We concur with you. We updated this section based on more recent empirical evidence.

* p4, line 20 : the aim described for the study is really interesting "which laboratory information exchange (LIE) systems and features" nevertheless I do not see much conclusions on the "features" that are used.

We will come back to that aspect at the end.

* p4, Line 23 : the notion of 'features' is also present and still appealing. We thank you for this comment.

As indicated in Table 3, system features correspond to consultation capabilities since physicians do not enter or manipulate laboratory data in LIE systems.
Methods:

* p5, line 8 : it is not clear how the framework present in fig1 guided the design of the survey to find answers to the research questions. Please elaborate.

* p5, line 23 : please elaborate on the link between the framework in fig1, the HIE literature and the actual content of the questionnaire. Displaying all or part of the questionnaire would also help, could authors do that ? at least key items, section titles, samples of most critical questions and link with content of table 3 & 4 (likely to be part of the survey if I do not misunderstand)

* p6, line 5 : once again, inside on the survey questionnaire would be very welcome.

As suggested, all survey items are now provided in Appendix.

* p6, line 16 : Author should qualify the statement that respondents are "quite representative" of the target SP population. No data are presented in support of that, please provide some.

As requested, we now provide clear evidence of the representativeness of our sample.

Results:

* p8, line 4 : If I am not mistaking, content of table 2 starts to be presented with the phrase "In addition, most SPs…". Please update to prevent reader from looking across the figures to identify the source of the information presented

You are right. We clarified this.

* p8, line 22 & p9, line 1-2 : Could authors comment on the CPOE feature ? "electronically request a laboratory analysis and print identifying labels for the samples."

Your comment made us realize that an important information was missing in the manuscript. We thus specified that, in Quebec, CPOE features are only accessed through LRVs. We also clarified that only 7% of the SPs with access to CPOE features were not using them.

* p13, line 2 : I am afraid that phrase "holistic view of the use of HIE by physicians for laboratory" is misleading. The manuscript deals with SPs and reference 40 with family physicians in Canada. This phrase should be more specific.
The reference was removed, and the sentence corrected.

* P14, line 13-16, one may expect comparison of results extracted for SPs with authors' previous results and conclusions from family physicians. Do both group face similar functionalities, use them similarly, etc.?

We thank you for this comment. We have done such comparison in three different parts of the article. First, in the “Results of the path analysis” section, when we report the results of the path analysis, we added a footnote explaining that the positive and significant path between the extent of iEHR consultation and the benefits from HIE use is consistent with previous studies among family physicians for which there is also a positive and significant path between the extent to which they use electronic medical records (EMR) and the performance benefits they derive from them [23]. Second, in the “Discussion” section, after we discuss the functionalities available to and used by SPs, we finalize the paragraph adding information from [23] and [46] about the specific laboratory-related electronic health record (EHR) functionalities available to and used by family physicians in primary clinics. Finally, in the “Discussion” section, when we explain the results of the path analysis, we added a footnote explaining that results are consistent with previous studies in primary clinics in which it has been found that the capabilities available in EMRs positively and significantly influence the extent of EMR use by family physicians [23].

Discussion:

* p15, line 11 : incomplete phrase spanning line 10, 11, 12. At least 1 word missing

This sentence was reworded.

* p16, line 4 & 6 : "additional analyses performed on our data" those are undisclosed analysis. Author should present the analysis they mentioned

We have provided the additional analysis in Table 7.

* p16, line 10 & 16 : intriguing result indeed, but what is the basis for the hypothesis made ? one may make many other hypothesis than emergency interventions. It is hard to believe that emergency alone can account for the 49.7 unit reduction.
We refer to a difference of 49.7% here, not a reduction. That means that from all the SPs having access to tests results produced outside their hospital but in their region, 49.7% choose not to look at these results (and hypothetically have the tests performed anew). This is this difference that we are tentatively explaining with the urgency proper to SPs, since this has never been studied in prior research. However, maybe urgency is not the most accurate term to be used to refer to the nature of SPs work, compared to GPs. Hence, we reformulated the section to clarify this.

Discussion & conclusion:

Systems studied were design with features supposed or expected to answer users' needs. Part or all of these systems & feature usage level (known in the author vocabulary as the 'extended use' of the system) are the subject of this manuscript, as well as system complementary nature. It would be interesting to read a critical analysis of the system(s) & feature(s) design goal(s) and use cases compared to the system(s) & feature(s) usage / 'extended use'. This may help ensure in the future (p19, line 9&10) "extensive use of HIE for laboratory medicine"; HIE as well as all combinations of EHR and LRV.

We thank you for this comment. Since we do not have access to the initial designers’ goals, we cannot compare them with extensively used features. However, this comment made us think about further implications of our findings for different stakeholders, namely system designers, vendors and integrators. We added these ideas at the end of the manuscript.

Reviewer 3’s comments:

The paper is generally well written and has some worthwhile insights to advance our understanding of variance in perceived benefits of three LIS.

Thanks for your positive introductory remarks.

Minor:
P2 Ln14 …TO emphasize prevention….

Done.

P2 Ln 15-21 Content is choppy. Reword. Might be as simple as removing sentence on Ln 15-16 This involves……safe manner.
This sentence was removed, as suggested.

P3 Ln5-12 You transition from LIS into a discussion about EHR is awkward. A sentence to explain the relationship between the LIS and EHR is required.

We agree with your comment. A paragraph was added, and we provided additional references.

P3Ln10 Refers to "low levels of adoption of health IT"….this is not consistent with the original citation. Change "IT" to "EHRs" and will be more consistent with source, and appropriate for this paper.

IT was replaced by EHRs, as suggested.

P4L19-20 You introduce the LIE abruptly. Please include a sentence on its role and utility in relation to LIS.

This comment was addressed with a previous recommendation by adding a new paragraph explicating the links between LIS, LIE and EHRs.

P8Ln3 Remove WHO

This sentence was reworded.

P15L1 You explain your performance benefits variance to differences in HIE capability, yet you describe the IEHR-LRV reliant physicians as located in urban areas. Could the performance be related to the fact that urban users are more likely to have encounters in more than one healthcare facility and thus SPs are more likely to access and use the IS, in addition to HIE capability? At the very least, should the conflation of the location factor be introduced rather than explaining it is primary due to IS HIE capability?

We are not certain to understand what you mean by IS. If you mean CIS and LIS, in Quebec these systems are accessed via an LRV (except of course for laboratory technicians, and other medical specialists who must input test results in LIS). HIE encompasses both iEHR and LRV so IS usage is already factored in and possibly participate to the greater capability (and complementarity). Also, we hypothesize all SPs to have similar workloads so performing it in several healthcare facilities should not make a difference.
Your study included a parsimonious set of individual characteristics. Please add "individual characteristics EXAMINED IN THIS STUDY" to better characterize your results.

Done.

Your suggestion that "features" are a more "objective" measure of performance is still filtered through a lens of performance measured by subjects’ assessment of perceived benefits. I'm not sure that you’ve proven that your assessment of performance is more objective due to usage of any one of three systems with different embedded features. The paper would not suffer from the removal of this paragraph as the claim of better conceptualization based on features is not strongly picked up at the end of the document, nor is the paper dependent on it.

We concur that the use of the term “objectively” can be misleading here. What we meant is that prior IS literature has failed to conceptualize IT artefacts at a micro-level. We clarified this important issue in the revised version.

Reviewer 4’s comments:

The article constitutes a contribution to the study of the use of one of the most important data sources in health information exchange systems, laboratory tests. It addresses a current problem, with a very good use of theories that can explain the extensive use and benefits of HIE. The proposed methodology is adequate and achieves very interesting results on how the benefits of an information technology determine its extensive use, and the components of the technology that are linked to these benefits and greater use.

Thank you for your positive introductory comments.

However, a specially designed questionnaire was used for the study that has not been previously validated. At the same time the validation is being used to evaluate constructs, which should be considered when analyzing the data.
We mention initially that: “As described below, we followed best practices concerning web-based survey methodology [31].” In survey research, with regard to questionnaire construction and validation i.e. the conceptualization and operationalization of the research constructs, it is important to distinguish content validity from construct validity. The first type of validity refers to the extent a measure (say of the ‘Benefits of iEHR consultation’) represents all facets of a construct. It is assured a priori by the thoroughness of the literature review that precedes the operationalization of the construct. The second type of validity refers to the psychometric properties of the construct (reliability, unidimensionality, concurrent and predictive validity), once it has been operationalized. It is assured a posteriori through statistical indices/coefficients calculated from the empirical data (e.g. Cronbach’s, % of explained variance). We thus believe that our construction and validation of the questionnaire conforms to the standard practices in this regard, as exemplified by previous articles published in the top medical informatics journals such as BMC Medical Informatics & Decision Making and International Journal of Medical Informatics. Also, please refer to our response to the Reviewer’s 3rd, 6th and 8th comments.

Despite being familiar with methods of statistical analysis and validation of data collection instruments, the results section was very difficult for me to follow, which can make the messages that the authors are trying to convey lose strength.

Please refer to our response to Reviewer 1, Reviewer 2 and Reviewer 3’s previous comments on the Results section for improvements made to this section. Moreover, we believe that our presentation of the results, and in particular the results of the path analysis (structural equation modeling, Figure 2) and the profile analysis (cluster analysis, Table 6), conforms to the standard practices in this regard, as exemplified by previous articles published in top medical informatics journals such as BMC Medical Informatics & Decision Making and International Journal of Medical Informatics.

Background

There is not a large amount that specifically addresses the use of the laboratory testing component in health information exchange systems from a clinical practice perspective. The background section states well the importance of this source of HIE clinical data and the need to better understand its extensive use as well as the benefits obtained in a hospital context.

Thank you for your positive assessment. This is very much appreciated.
Methods

The proposed methodology is suitable for established research questions. The framework developed is consistent with those identified in the background and the three broad categories identified as contextual factors (users, technology and organization) correspond to what the literature on IT adoption and use consistently reports.

The methods section is brief, and much of the proposed statistical analysis is found in the results section.

Thanks again for your positive remarks.

When using an online questionnaire, the instrument validation issues are very important. The authors used a questionnaire specially designed for this study, which adds to the complexity of validation. The development was based on a review of previous literature and qualitative methods (interviews).

- There is no mention of whether a validation of the content of the instrument was carried out, a process that improves the formulation of the questions.

- The number of domains and items per domain is not specified.

- It is also not mentioned if a pilot application of the instrument was carried out.

It is mentioned at the end of the section that an item analysis was performed to validate the two HIE use indexes and the internal validity of the two impact measurement scales of the use of HIE systems was evaluated with the Cronbach coefficient.

With regard to instrument validation, we first mention that: “The survey questionnaire was built following the previously mentioned review of the extant HIE literature and a series of interviews with 25 physicians located in 11 different regions of Quebec.”

The number of research domains/constructs (n=7) is inferred from the study’s conceptual framework (Figure 1), whereas the number of items/indicators per domain (e.g. 11 for the ‘Benefits of iEHR consultation’ domain) is inferred from the results presented in Tables 1, 3 and 4 as well as from the survey instrument itself (now provided in Appendix).
With regard to instrument validation, we also add that: “Developed with the Qualtrics online survey platform [32], the survey instrument was first approved by the province’s health authorities and then pre-tested with 10 physicians. Each physician was interviewed about the questionnaire’s format and instructions, as well as the wording of questions and possible answers, to ensure that they were interpreted as intended by the researchers. Following a few minor adjustments to the survey instrument, the study received final approval from the ethics committee of each researcher’s institution.”

When reviewing the results, some statements are complex. For example: “As most of my patients reside in the region, I have little use for the QHR because the viewer provides me with most of the lab test results that I need (answers using a scale of Likert of 1 (strongly disagree) to 5 (strongly agree)). The question has several components, proportion of patients residing in the region, use of the QHR, benefits of use, in addition to the statement that may be difficult to understand.

As mentioned above, the development of the survey items was performed according to best practices. It was inspired by the extant literature and based on a series of interviews with 25 specialist physicians located in different regions of Quebec. The particular statement that the Reviewer refers to in his/her comment indicates that a physician may not need to consult the provincial QHR system because all lab data about his/her patients can be quickly found in the regional LRV system.

Results

In the results section (page 10, line 8) it is indicated that an evaluation of the psychometric properties of the construct indicator (measures) was carried out and details are given. Not being an expert I have doubts about whether it is sufficient to ensure the validity and reliability of the questionnaire used.

Please refer to our response to the Reviewer’s 2nd, 3rd and 6th comments, as well as to our response to Reviewer 1, Reviewer 2 and Reviewer 3’s previous comments on the Results section for improvements made to this section.

The short explanation of the LRV and the iHIE can be moved to the methods section (page 7 line 21). A brief but better description is suggested, particularly of the differences between the RHIEP and the iHIE.
We considered the possibility of moving this material to the methods section, as suggested. However, we have decided to leave it where it is so to maximize the overall flow and cohesion of the paper. For clarity purposes, we added more details about RHIEP and iHIE in footnotes.

The results section mixes methodological details that may not be easily understood by clinicians, policymakers, educators, so we suggest reviewing them. Certain analytical methods such as path analysis (structural equation modeling) and profile (cluster) analysis require, by definition, that methodological details (with regard to construct validity for instance) be presented in the Results rather than in the Methods section.

Now, when the readership of a scientific journal includes not only researchers but also savvy practitioners, there is always a quandary as to the full extent to which the study’s methodology must be presented. In order to satisfy the primary mission and readership (of BMC Medical Informatics & Decision Making in this case), establish a rigorous foundation for the paper’s research findings and recommendations, the wisest course for researchers is to follow the standard practices in this regard as exemplified by previous articles published in the top medical informatics journals such as BMC Medical Informatics & Decision Making and International Journal of Medical Informatics, which is what we have done here. Thus, even though practitioners may not understand all details of the scientific method upon which these findings and recommendations are based, they must be nonetheless convinced that this method is scientifically rigorous if they are to adhere to these findings and follow upon these recommendations.

Table 1 is a mixture of contextual characteristics of participants and hospitals with data on the use of the different HIE (table two also contains these data), which makes it difficult to follow the text. A better option might be to separate them into two tables. It is interesting to note that there are no clinicians who do not use any of the systems which confirms the extensive use of them in relation to paper registration.

The statement "retrieve lab results through more than one HIE system" (page 8 line 4) contains data from table 2, which is not yet entered in the text. We have reformatted Table 1 so that its three parts are now more clearly separated. Thus, each part now stands alone.

The statement has been changed to: “As shown in Table 2, most SPs (72%) are found to retrieve lab results through more than one HIE system.”
Table 2 is not adequately introduced and explained in the text, particularly when « HIE use cases » and « LRV use cases » notions are used. Later on we talk about HIE usage profiles, maybe this last concept is more relevant.

We now introduce Table 2 in the following manner: “Table 2 presents the different types of HIE systems used by the respondents. In this regard, there appears to be three HIE use cases, a first case in which a SP uses only the iEHR, a second case in which he or she uses only a LRV, and a third case in which both types of HIE systems are used in combination.“ Please note that, thus presented, the ‘HIE use case’ notion totally differs from the ‘HIE usage profile’ notion later introduced in the paper.

Table 3 is well introduced but contains a questionable statement: “possibility of electronically requesting a laboratory analysis is a capability that is available in only 55% of the LRV systems consulted by the SPs”. In the table we can see that the statement also considers the ability to print the identification labels of the samples. We see then that the statement evaluates two functionalities.

The description of tables 3 and 4 is less confusing and contains very interesting information regarding the key functionalities of each system and the benefits obtained. In all LRV systems observed, ‘printing the identification of labels’ is not a separate functionality but rather a sub-functionality of the ‘electronically requesting a laboratory analysis’ functionality. To be more precise, we thus have modified the sentence as follows: “possibility of electronically requesting a laboratory analysis and printing identifying labels for the samples is a capability that is available in only 55% of the LRV systems consulted by the SPs.”

The description of table 5 and graph 2 are central to the article and perhaps deserve more space. It is noteworthy that there are no comments regarding the determination coefficients, very low in the case of "Extend of iHIE consultation". An explanation that the chosen variables "size" and "location" are only a small proportion of the contextual factors that the "hospital" organization may include.

With regard to Table 5, we believe this table is adequately presented as is, given that its purpose, in a structural equation modeling context, is essentially methodological, that is, to present the correlation matrix of the research variables and confirm the reliability and validity of their measure. With regard to Figure 2, we have added the following:

“Moreover, the organizational, IT artefactual and user characteristics that constitute the context of HIE systems use were found to explain a significantly greater percentage of variance in the SPS’ extent of LRV consultation (27%) than in their extent of iEHR consultation (7%).”
We also add in the Limitations section that: “However, as the hospital’s size and location explained only a small percentage of variance in the extent of HIE systems use by SPs, other organizational characteristics and in particular the hospital establishment’s status (e.g. general/secondary care/ vs. specialized/tertiary care establishment, non-affiliated vs. university-affiliated establishment) should be accounted for in future research. The same could be said of user characteristics, where the SPs’ gender and medical experience should be complemented by other characteristics such as their HIE experience and medical specialty.”

Discussion

The discussion is adequate, with the exception of the limitations of the study, which should be updated once more details of the questionnaire are incorporated (development, characteristics and validation).

Given the added explanations given and modifications made to the paper in the Methods and Results sections with regard to the construction and validation of the research questionnaire, and given the paper now conforms to standard practices in this regard, we believe no further updates to the limitations of the study are needed, apart from the one limitation denoted in the Reviewer’s preceding comment and in Reviewer 1’s 2nd and 5th comments.

I emphasize that in the discussion a very good point is made in the contributions of this study and what other research methodologies could contribute to this line of research.

We thank you for this final comment.