Author's response to reviews

Title: Use of a health information exchange system in the emergency care of children

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Author's response to reviews:

Dear Dr. Patel,

Thank you for the opportunity to revise our manuscript, “Use of a health information exchange system in the emergency care of children”, (MS: 7554258345315033). Below, please find a response to each of the reviewer’s comments. We believe the manuscript is greatly improved thanks to their comments.

Thank you,
Joshua R Vest
Reviewer 1.

Major compulsories:
R1. 1) I do not see the institutional review board clearance. Please document this.
Noted in methods section.
R1.2) Please state your inquiries more explicitly as specific hypotheses or questions. Hypotheses should be in a falsifiable form (Yes or No) an you have them in an exploratory format ("HIE usage will vary according to factors indicative of..."). Questions are useful to characterize some of the other aspects of the study, such as the different patterns of use and what they mean in relation to care.
We have changed the introduction to read as a research question: In this examination, we address the question, what factors indicative of an information need or value of using HIE are associated with HIE usage?
R1. 3A) There are other factors, such as accessibility and usability of "the system" that should be addressed or described (ie. time to get the information, it appears that the system in the EDs studied had relatively quick accessibility, but this should be described as accessibility/usability may vary across different EDs).
Does this factor into 9% (as opposed to higher use)?

We have expanded our treatment of the limitations section to cover these issues as we do not have data to accurate describe these features. Particularly, since we do not interview individual users, we do not know the perceived usability of the system. However, we note that our random-intercept models adjust for these differences across locations. We just do not know their effect. Instead of reproducing the entire additions here, we simply note we have a new Limitations subsection.

R1. 3B) Also, the measure of time constraint is interesting, but how valid or robust is this (ie. how did you validate this measure (since it was binary as opposed to continuous)?)? It would be useful to have a feel for how this manifested at the unit/care level.

We were unable to find a suitable measure (that we could replicate with our data) in the literature, so the time constraint measure was created. Unfortunately, we have not measure of validity or robustness, although it was applied in our previous HIE examination among an adult population. We chose to conceptualize the variable as binary, because we did not think it would be appropriate to try the variable as a continuous measure. With only this rough measure, we did not want to be in the position of trying to determine the incremental effects of having more patients that particular day. We replaced time constraints with busier than average day in several places in the results and discussion to reinforce how this measure was created.

R1. 4) You discuss patterns in terms of screen access sequences that are not clear. Specifically, there is one pattern ("routine") that accounts for a large number of requests. The rest ("novel") is not well characterized. Is "routine" the starting point for other patterns? How are these linked to information need? You have parts of it here. In most cases, an ED physician will need to know the recent history of a "frequent flyer" and would like to know where the patient has been within the network of service institutions ("routine"). What are the other uses? Tying these findings together with known cognitive factors (urgency and belief that an answer exists (Paul Gorman's work)) in contrast to your findings (with examples of "novel" (or non-routine use) would be helpful.

First, we changed from “routine” usage to “basic” usage to match the language of our other publication. We have added more detail to our description of our dependent variable. The section now reads: Through the logged date and time, we are able to follow the sequence of screens viewed by each user for a given patient on a given date. The entire sample included 77 different patterns of screen views in the associated log file. A single pattern accounted for 82% of sessions; this pattern consisted of an end user identifying a patient on a selection screen and then viewing a single screen containing a summary of recent encounters. We classified this type of session as basic. All other session patterns were classified as novel. This type of session consisted of any user session that included additional screen views (such as medications, a demographic summary, or detailed encounter records) beyond the initial patient selection screen and summary of recent encounters.
Second, in order to contrast our findings with research by individuals like Gorman and his colleagues we have added the following:

Overall, these results complement to the broader literature on the determinants of information seeking among clinicians. For example, research by Gorman and Helfand, although focused on knowledge-based resources, reported information seeking was associated with the urgency of the patient’s problem.[46] A similar phenomenon was evident in this study, as an increasing number of diagnoses was associated with an increased odds of both types of system usage. Also focused on the use of knowledge-based resources, Ely and colleagues [47] identified a lack of time as a barrier; in like manner, we reported if the day had more encounters than average, the odds of routine usage decreased significantly. Lastly, investigators have begun to catalog the types of information desired by providers from HIE systems.[44, 48] While our study does not look at system access for specific data elements, our measure of basic usage represents the factors associated with access of summary patient information.

Reviewer 2.

R2.1A) I only have two concerns about the paper. First, the authors don’t compare and contrast these results with those reported in the JAMIA paper. This seems like a major missed opportunity to compare use in the pediatric population vs. adult population using the same methods in the same setting.

We have added the following discussions as requested to:

• The paragraph beginning, Another traditional driver of information seeking, unfamiliarity…

• The paragraph beginning, While this study does not measure the exact type of information sought…

• The paragraph beginning, The only primary diagnoses category associated with both types of usage…

R2.1B) Second, much of the discussion provides very speculative explanations for results. These include speculations that “for unfamiliar patients, more attention might be paid to obtaining a thorough history, reducing any perceived need for HIE.” While I wouldn’t rule this out, it seems unconvincing. I certainly wouldn’t expect a formal qualitative analysis, but did the authors reach this speculation through any informal discussion with HIE users? It is also asserted that “usage is more beneficial to administrative functions than clinical functions” because of the OR of 1.5-1.6 for “unknown/multiple payer vs. Medicaid.” Although the OR is statistically significant, Table 1 shows that only 3.7% of encounters were for “unknown/multiple recorded payers” – so it is very unlikely that the administrative benefit of clarifying insurance coverage for this small minority of encounters was “more beneficial” than the clinical benefit in the vast majority of encounters. Finally, the authors speculate about why, in cases of injury and poisoning, the adjusted OR was positive (1.15) for routine use and negative (0.8) for novel use. Since these are small ORs that are barely statistically significant (1.06-1.26 in routine use, 0.66-0.97 in novel use), the speculation about investigations for abuse driving differences in routine vs. novel
use seems disproportionate to the findings.

We have attempted to reign in our more speculative language in the discussion specifically, we made the following changes:

Our 2nd paragraph of the Discussion was re-written to emphasize the need for qualitative research and reduce our number of potential explanations. Possibly for unfamiliar patients, more attention may be paid to obtaining a thorough history, reducing any perceived need for HIE or repeat visits may prompt providers to be more attentive treatments and care from other locations. These counterintuitive findings underscore the need for more qualitative research to completely understand users’ intentions.

Discussion paragraph 3, we deleted: Next, it appears usage is more beneficial to administrative functions than clinical functions as few diagnoses categories were associated with system usage, either novel or basic. We discuss the role of injury diagnoses in the next category and agree the direct contrast between clinical and administrative information may be overreaching. The end of the paragraph now reads: In addition, charity care was associated with novel usage and encounters with unknown payers were positively associated with all types of usage. Usage during these encounters that could prove more costly to the facility may represent an attempt to locate more information about the patient or a history of payer eligibility. Finally, although previous research indicates a demand for lots of clinical data elements from HIE systems in the ED setting, few diagnosis categories were associated with either type of usage.

Finally, the reviewer commented on the small effect sizes related to encounters with injury and poisoning. We believe this is an important potential advantage of HIE systems and supported by the opposite effects in usage. However, we do not want to oversell the conclusions or sound as though we have definitely elucidated cognitive processes. Therefore, we have deleted the last sentence of the paragraph (The two differing results taken together suggests that once concerns of abuse are excluded, externally generated information is not as applicable to the care of injuries).

R2.2) In the discussion, explicitly compare patterns of use in the pediatric population to patterns in the adult population reported by the authors in the JAMIA paper.

See R2.1A above.

R2.3) Please consider revisiting the speculations in the discussion to address the concerns above. A screen shot of the summary screen that constituted “routine use” would be very helpful.

See R2.1B above for the discussion section changes. While we understand a screenshot would be helpful and actually would like to include one, we have not been granted permission to include screenshots in publications and therefore cannot.

Reviewer 3

R3.1 My review of this article focuses primarily on the statistical methodology.
There are no major quarrels with the correctness of the models used and the associated inferences. However, there is one major shortcoming regarding the interpretation of the fixed effects terms of the models. Although logistic regression models with random effects can be used to model association in the data, the interpretation of the fixed effects parameters can be tricky and less transparent. Typically for the logit link function or any non-linear link function, the fixed effects parameters have the so-called subject-specific interpretation. That is, the fixed effects parameters measure the change in the log odds of the event being modeled for variables that change within the level of random effects. Thus, the interpretation of the fixed effects parameters in terms of odds ratios is only natural for covariates that change within a patient. For covariates that do not change within a patient such as gender, race/ethnicity, etc..., the odds ratios need to be derived from the marginal probability. This marginal probability is obtained by averaging the conditional probabilities over the distribution of random patient and random location effects. This issue is beautifully described and discussed in the book by Fitzmaurice et al. (2004), pages 331-338. This is definitely a major problem in this article. The authors should consult a statistician to provide the right interpretation of the fixed effects regression coefficients, and to obtain population-averaged odds ratios. Another option is to use population-averaged models such as GEE-based models, but the number of locations in the data set may not be high enough to support asymptotic results. References: Fitzmaurice GM, Laird NM and Ware JH. (2004). Applied Longitudinal Analysis. New York: John Wiley and Sons.

We thank the reviewer for bringing up this important issue. We have a statistician on board who oversaw the statistical analysis for this project. We fully agree with the reviewer on the limitation of the random effect logistic regression model approach for our example, since the fixed effects carry a conditional meaning, i.e. they are the effects conditional on a subject. What we are really interested in is the population average effect. However, there are problems with using a GEE-based model here, since (1) it is not easy to use GEE to model the correlations for binary data, since the correlations are functions of the means, and (2) it is difficult to model the correlated nature for three-level data in GEE (3) the number of locations in the data set may not be high enough to make the robust variance estimators work. In contrast, the random effect logistic regression model provides a convenient way modeling the 3 level data (visit, patient, hospital), but the odds ratio estimates are subject-specific effects, not population averaged effects. As the reviewer pointed out, we can obtain the marginal probabilities by integrating over the random effects, however, the marginal probabilities do not follow a logistic regression model anymore, so it is still not obvious how to interpret the results. Given that there is no ideal way to perform the analysis, we choose to keep the random effect logistic regression modeling approach, but caution the readers that the estimated effects are subject-specific effects, and the marginal effects which are of interest are usually smaller. We believe that we are not alone in choosing this approach, since the multi-level model for binary data (i.e. random effect logistic regression model) has been widely used in the health, social and behavioral sciences, and covariates at higher levels are often included in the models.
We added the following at the end of the Methods section:
The advantage of a random effect logistic regression model is its ability to model the correlated nature of the binary data arising from a multi-level structure; it is difficult to do so using the alternative approach of the generalized estimation equations. However, the interpretation of the fixed effects from the random effect logistic regression is not very transparent, since they carry a subject-specific meaning, instead of indicating a population averaged effect. In general, the population averaged effect is smaller than the subject-specific effect. Hence, we need to keep this in mind when interpreting our regression models.