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Iterative Approach for Census Error Reduction in a Homegrown HL7-FHIR Application

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***Abstract*—Implementation gaps exist for secondary use of EHR-generated data. We Leverage HL7-FHIR resources served from EPIC to populate an internally developed acute-care multi-patient viewer (AMP). The aim is to identify census errors during sprints of application development for iterative improvements. Between 4/15/20-5/26/20, census errors between EPIC and AMP are communicated to IT team. We observe a reduced average percentage from 7.93% to 2.53%. Validation of the census provides an indispensable feedback-loop for the developers for fix deployment. This highlights the need for an automatic validation of FHIR messages on the receiving /user side for a complete and more accurate census.**

***Clinical Relevance*— The implementation of EHR results in information overload with multiple inboxes and unnecessary alert. To mitigate this problem, we implement a tool for central alert screening that serves as a cockpit for caretaker. Essential to its success is an accurate near real-time patient census.**

I. INTRODUCTION

Although EPIC has adopted HL7-FHIR standards, certain implementation gaps exist for secondary use of Electronic Health Record generated data. We implement FHIR resources from EPIC served to an internally developed, acute care multi-patient viewer (AMP) (Mayo Clinic, Rochester, MN), for use by providers across the entire enterprise. The aim of this paper is to describe the gaps in HL7-FHIR as implemented in EPIC as they relate to one critical aspect of AMP – the inpatient census, and to describe the approach taken by our team to eliminate those gaps.

II. METHODS

A pipeline for data transfer is developed and deployed using FHIR STU2 from EPIC to AMP, such as Encounter, Problem, Document Reference, and Observation. Theoretically, resource creation and status change data would flow smoothly from Epic, through various systems, to AMP. However, the patient census within AMP could not always be reconciled with the situation on the ground or as encountered in EPIC. Due to lack of automatic systems, we need to compare the census manually at this stage so we can gain an insight into what is causing the delay in change or other errors. During a random time within each workday between 4/15/2020 and 5/26/2020, the census of patients between EPIC and AMP is tabulated and analyzed by 2 researchers, this included identification of difference in bed assignment between EPIC and AMP (such as patient 1 moved in EPIC from room 1 to room 2, but still occupies room 1 in AMP, resulting in multiple census errors), and Temporary bed (not shown initially in AMP). The census errors are then communicated to the IT team.

III. RESULTS

On average, there is a decrease in the number of census errors between EPIC and AMP over the study period from 7.93% (week 1) to 2.53% (week 6), and 10-day Exponential moving average from 16.2% to 5.54%. The errors in census are attributed to 2 main reasons: First, there is a break in transmitting a message through various systems. This is most evident on two dates (5/5 and 5/15). The IT team discovers that the Palliative care Decision Server Insights pipeline is down (issue resolved in 4 hours). Second, The AMP was modeled against the physical floor plan of St. Marys Hospital. During our daily census checkups, we notice the need for additional logical beds to support patients that are in temporary locations (pre-anesthesia, post-surgery, radiology). This ability is added to the AMP on 05/15. The average error of temporary beds drops from 5.42% ± 1.9 (before 5/15) to 4.32% ± 1.67 after 5/15 at first iteration (3 temporary beds per section), which was increased in later iterations (not shown). This difference is statistically significant using Wilcoxon signed-rank test ($W=9$; $p=0.0001$).

IV. DISCUSSION & CONCLUSION

Due to the dynamic nature of the feed such as temporary movement of patients, there is an expected delay in census reconciliation between Epic and AMP. Through an iterative feedback loop, we identify and close gaps in the census from information delivered through our FHIR pipeline between EPIC and AMP. This results in:

1. Identification of census error spikes, resulting in fast problem identification and implementation of a fix.
2. Decrease in percentage of census error over the study period due to feedback loop to the IT team.

There are no current software tools to test the user perspective of the data being transmitted, hence our use of manual validation. The current validation is also time consuming (mean = 76.33 min/day), and represents a cross-sectional snapshot but establishes a daily feedback loop indispensable in identifying critical problems and directing IT resources toward fixes that could be deployed in a timely fashion. This problem is not unique to our implementation since all healthcare systems rely on multitude of systems interjected between the source (EMR) and the end-user application; the findings are also generalizable to all FHIR implementations, since there is a need for automatic FHIR message validation, in the absence of an out-of-box solution. This exploratory study serves as a building block for future works on automatic census validation. There is a need for a scalable and automatic mechanism to validate FHIR messages on the receiving /user side for a complete and more accurate census.