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Evaluation of Telehealth Service for COVID-19 Outpatients: A Dashboard to Measure Healthcare Quality and Safety

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Abstract

Due to the COVID-19 pandemic, changes and improvements regarding the organization have been made to adapt quickly at the Emergency Department (ED) of the Hospital Italiano de Buenos Aires, Argentina. This article describes the design, implementation, and use of an electronic dashboard which provided monitoring of patients discharged home, during follow-up with telehealth. It was useful to access essential information to organize and coordinate professional work and patients' surveillance, providing highly relevant data in real-time as proxy variables for quality and safety during home isolation. The implemented tool innovated in the integration of technologies within a real context. The information management was crucial to optimize services and decision-making, as well to guarantee safety for healthcare workers and patients.

Keywords:

Emergency Medical Services, Hospital Information Systems, Data Science.

Introduction

On March 20, 2020 Argentina's government declared a national emergency to battle the COVID-19 pandemic with a lockdown status and begin mandatory quarantine [1]. However, the Emergency Department (ED) suffers from a long time ago (predates this pandemic), a worldwide phenomenon called crowding [2, 3]. In light of possible saturation of the health system, with the aim to optimize the availability of hospital beds [4], it was not until June 2020 that our Ministry of Health enabled the management of confirmed COVID-19 cases with mild clinical symptoms or asymptomatic as outpatients. Consequently, our institution began on June 22, 2020, to discharge home those patients (COVID-19 confirmed) with mild clinical symptoms or asymptomatic, immediately after the initial evaluation and diagnosis at the ED. We used telehealth to follow up these patients (during isolation at home), and it was almost mandatory to make some evaluation of outcomes related [5]. Quality and safety are allowed review through an electronic dashboard, which provides an opportunity for real-time assessment and intervention.

Availability of reliable data has for a long time been a challenge for health programmes in Argentina. We already know from literature that poor investment in health information systems has led to challenges like weak human resource capacity, data infrastructure deficits, weak monitoring and supervision and non-existent feedback on data quality [6,7].

From literature review, we already know that technology helps patient care and professional workflow [8]. There are even more sophisticated experiences, such as South Korea, where they adopted a vital sign monitoring mobile app and smart devices so that medical personnel could view the vital signs and symptoms of all patients [9].

In this contextual framework, changes and improvements regarding the organization were necessary to adapt quickly. An electronic dashboard innovates in the integration of technologies within a real context; it brings the benefit to quickly adapt in real-time [10] to growing demand, typical of epidemiological pandemic variations. In this way, it should help clinical decision-making [11] and hospital administration [12].

This paper aimed to describe the design, implementation, and use of an electronic dashboard that would allow visualizing indicators of telehealth follow up through the use of engineering and data science.

Methods

Setting and data collection

This study took place at Hospital Italiano de Buenos Aires, a community-based tertiary care hospital located in Buenos Aires, Argentina. It has an ED that provides services for unscheduled consultations 24 hours a day, 365 days a year, and usually attends about 160,000 consultations annually.

All patient health information is stored in a single Clinical Data Repository (CDR) fed by the hospital electronic health record (EHR). The CDR stores clinical documents for each patient, with the highest quality standards worldwide. The hospital health system has been evaluated by a recognized international organization (HIMSS, Level 7+) and accredited by the Joint Commission International.

Design and development

The Biostatistics and Business Intelligence team at the Health Informatics Department and the ED team set the requirements for the project, which were ready in July 2020.

Several transactional systems were analyzed for data collection and taken into consideration to feed the dashboard. These transactional systems, such as Patient Admission System, Triage, EHR, Laboratory, and COVID-Enroller, served as input of crucial variables needed for this project. We use Pentaho as an ETL (Extract, Transform and Load) tool to bring this data from transactional systems and save it in our data warehouse and make the data modeling needed to maintain data quality. In this way, we agglutinated in our data warehouse all the

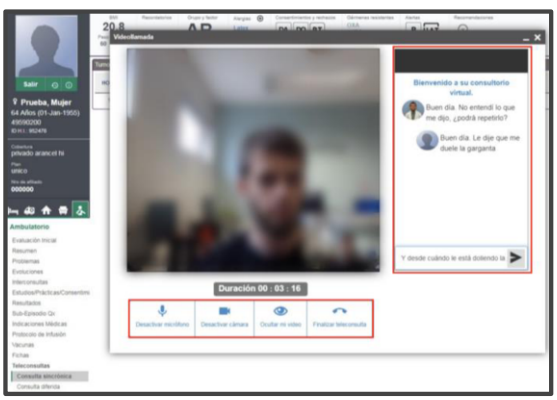
information required from several transactional systems of the hospital to load the data accurately in the dashboard. We applied Business Intelligence (BI) using IBM's BI Cognos Analytics. This tool puts together the metadata to visualize the information through indicators placed in an interactive dashboard. The user can manage the system to follow-up active COVID-19 patients.

Results

Telehealth follow-up

All patients involved were followed after discharge from the ED using a telehealth program. At the diagnosis, a video-call consultation was scheduled between patients and physicians. As interfaces, patients used their Personal Health Records (PHR), and the health team used the EHR; both systems are interconnected to perform proper audio, chat, and video-call communication. The development of the tool was previously designed ad hoc at the hospital (**Figure 1**).

***Figure 1**. Teleconsultation system, EHR view.*

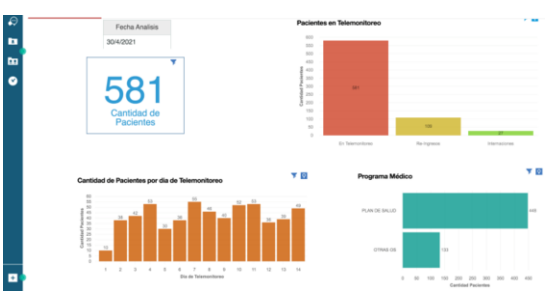


When receiving a positive test result, patients were scheduled with a first video call up to 24 hours after discharge from the ED. Based on the assessed clinical status of the patient during first control (examples: persistent dyspnea or fever, comorbidities, and risk factors), physicians rescheduled a second appointment for the next 24 to 72 hours. Based on findings at the second encounter, they were able to reschedule a third one, if needed. This remote surveillance of outpatients ended up to ten days after diagnosis (from ED discharged).

Dashboard prototype

The resulting dashboard prototype is presented in **Figure 2**.

***Figure 2.** Dashboard prototype (screenshot from April 2021)*



Every 24 hours, the system automatically updated the information, including real-time data up to the previous day. Initially, the three most relevant indicators of the dashboard were: (a) Cumulative number of active outpatients being followed with telehealth; (b) Number of patients by day of follow-up (1 to 14), this allows to visualize fluctuating epidemiological variations of cases; (c) Number of patients by insurance, to organize human resources and workflow.

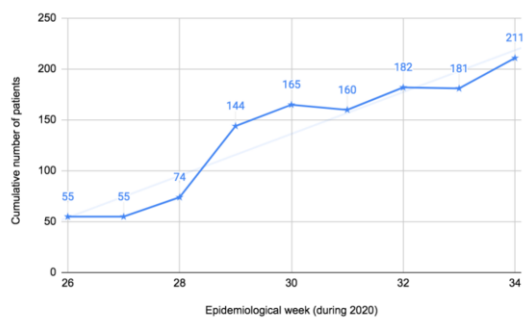
The Argentinian health system is composed of a complex network of service providers, which fall into three different subsectors: (i) public, (ii) private; and (iii) private health insurance, which includes a variety of plans. Our hospital only guarantees telemedicine follow-up for people affiliated with our own private insurance plan (PS-HIBA), with approximately 160.000 patients.

In practice, it behaves as a dynamic prospective cohort of patients being followed over time, from the initial evaluation and diagnosis until 14 days after ED discharge, exploring rates of specific outcomes as needed. After 14 days, discharged patients were withdrawn from the dashboard.

Implementation and Use

The dashboard has been used since July 27, 2020, displaying reliable and real-time information. The number of active cases increased week-by-week after its implementation (**Figure 3**). A total of 1,239 patients were discharged home (for outpatients management) from the ED and followed with telemedicine between June 23, 2020, and August 23, 2020.

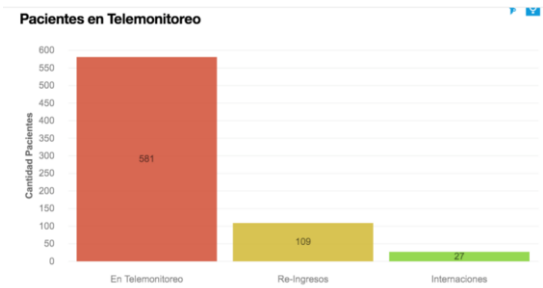
***Figure 3.** Cumulative COVID-19 outpatients by weeks after dashboard implementation on July 2020*



Up Date for healthcare quality and safety indicators

Based on this previous experience with only descriptive information, in December 2020 we added new outcomes to monitoring patient-safety, defined as the occurrence of: a new face-to-face consultation in ED, or a further unscheduled hospitalization. Both outcomes were included as primary indicators of dashboard (proxy variables of safety during isolation with telehealth follow up): ED-readmission rates and hospitalization rate, reported as a cumulative incidence within 14 days of follow up until epidemiological discharge (18% and 4% respectively in **Figure 4** on April 30, 2021). Monitoring these indicators played a crucial role in the health care system.

Figure 4. *Healthcare quality and safety of COVID-19 outpatients. X axis contains three bars with real-time date of: (orange) total number of active COVID outpatients; (yellow) ED-readmission rate; (green) hospitalization rate.*



Discussion

The experience of developing our prototype and designing the software to meet specific and tailored requirements, allowed the surveillance and evaluation of confirmed COVID-19 cases for outpatient management, developed in record time, and centered on user needs. Related outcomes after ED discharge could have tremendous implications for care quality, public health, disease surveillance, and practice-based learning across a great many use-cases.

The main strengths of this project were: (a) data quality; (b) it was easily understood by end-users (physicians, researchers, and decision making authorities) to track the outbreak as it developed; (c) data privacy: patient confidentiality was guaranteed, the data was de-identified, and the access to the dashboard was restricted only to staff and by using a secure username and password. Despite this, the article describes a unicentric study, hard to generalize to other centers due to the tailored development; although easily reproducible.

Dashboards have recently received the spotlight as healthcare information technology to support healthcare decision-making and tasks [13].

The data could be used to inform healthcare planning in preparation for the next phase of the pandemic. Having accurate and timely information presented in a user-friendly way would give us a better understanding of the situation to make better decisions when caring for patient health [14]. The next step, for the future, could be to create and validate a prediction tool for in-hospital mortality to support frontline clinical decision making [15].

Conclusions

This information provided by the interactive dashboard, with reliable and real-time data, was crucial to optimize services and decision-making (in terms of human resource: needs, quantity and functions), as well to guarantee safety for patients, and healthcare workers.

Related outcomes after ED discharge, through the use of engineering and data science, could have tremendous implications for care quality, public health, disease surveillance, and practice-based learning across a great many use-cases.

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