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Can CPOE Based on Electronic Order Sets Cause Unintended Consequences (Expensive and Unnecessary Tests) at the Emergency Department?

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Abstract

Computerized Provider Order Entry (CPOE) systems may cause unintended consequences. This study aimed to describe the on-going system for CPOE order sets, and to explore an economic evaluation at the Emergency Department. First, we developed a costs dashboard which showed us the significant and excessive use of medical tests per consultation. We identified the top 10 most widely used and most expensive tests. Additionally we noticed that the labs seemed to continually increase. Then, we found that 27% of the consultations have at least one item of laboratory practice between January and February 2020, and this represents more than 80% of the consultation costs. Health care spending has reached epic proportions globally. We think that it is time to rethink effective strategies. Maybe it is time to deactivate/remove electronic order sets (EOSs) and the functionality to develop and create their own "private" order sets, in order to eliminate waste and inefficiencies.

Keywords:

Medical Order Entry Systems; Medical Overuse; Emergency Service, Hospital.

Introduction

Computerized Provider Order Entry (CPOE) in health care has been introduced across the healthcare system based on a business model suggesting savings from improved patient safety [1].

Historically, CPOE has been implemented in drug prescribing and has been shown to reduce medical errors and adverse effects [2]. However, less attention has been paid to the impact of CPOE in laboratory and images order tests. A growing body of evidence has demonstrated the benefits in this matter, especially the order sets; these quick orders have the potential to improve provider efficiency by conveniently grouping orders together and can influence provider behavior based on evidence [3].

Institutions invest in CPOE systems with the expectation that they will result in faster delivery of test results to physicians which will increase the likelihood of quicker diagnosis and treatment decisions. CPOE systems and Clinical Decision Support System (CDSS) have been successfully implemented among inpatient services, but there is not enough evidence about their efficacy in the Emergency Department (ED). There are pros and cons regarding CPOE in the different investigations. Some reports like Westbrook et al [4], showed that the implementation of CPOE reduces the test Turn Around Time and is directly related to length of stay in ED but, on the other hand, CPOE could increase times for laboratory and imaging requests in the ED as Syed et al. [5] reported in their analysis results. These situations reveal that more research that measures the CPOE/CDSS system is needed. It is important to emphasize that it is necessary to consider the ED environment in the investigation.

Otherwise, ED faces significant challenges in delivering high quality and timely patient care on an ever-present background of increasing patient numbers and limited hospital resources [6].

Unnecessary healthcare utilization, non-adherence to current clinical guidelines, or insufficient personalized care are perpetual challenges and remain potential major cost-drivers for healthcare systems around the world [7]. Reasons for this include excessive use of unnecessary and expensive tests, high administrative costs and prices, inefficient use of services and equipment, and missed opportunities for prevention. Additionally, patients can suffer direct (e.g., medication side effects, radiation exposure) and indirect (e.g., impact on caregivers) harm from overuse of tests and treatment protocols.

Health IT professionals played an important role in the implementation of systems that could solve many of the problems mentioned before. Nevertheless, some reports have demonstrated that these applications that support the healthcare processes could cause unintended consequences [8]. These types of consequences also can trigger excessive resource uses and adds unnecessary costs to the delivery of healthcare.

In this article, we aimed to describe the on-going system in electronic health records (EHR) for CPOE order sets in ED settings; and to explore an economic evaluation of metrics as detailed cost components in order to rethink effective ways to eliminate wastes and inefficiencies.

Methods

Setting

Our study took place at Hospital Italiano de Buenos Aires (HIBA), a community-based tertiary care hospital located in Buenos Aires, Argentina. It has an ED that provides attention for unscheduled consultations 24 hours a day, 365 days a year. The infrastructure consists of four areas of care, differentiated according to complexity, which is defined by the patient's condition at admission. Patients on admission are evaluated by triage-trained personnel, who according to the baseline clinical condition classify them using a color code (green, yellow or red) according to increasing complexity, with different waiting times.

Design, participants and data collection

We conducted a cross sectional study which included all consecutive adult patients admitted to the ED between January and February 2020.

Eligible patients were captured by using secondary databases with administrative data sets containing different variables: time of arrival, triage process, time of initial provider examination, medication prescription, tests with administrative costs and/or prices, admission order, discharge order.

All patient health information is stored in a single Clinical Data Repository fed by the hospital EHR. HIBA is a HIMSS Level 7+ organization with an in-house-developed health information system. It features a web-based, problem-oriented EHR; a terminology server referenced to SNOMED CT; and an integrated personal health record (PHR) [9]. The hospital health system has been evaluated by HIMSS and accredited by the Joint Commission International.

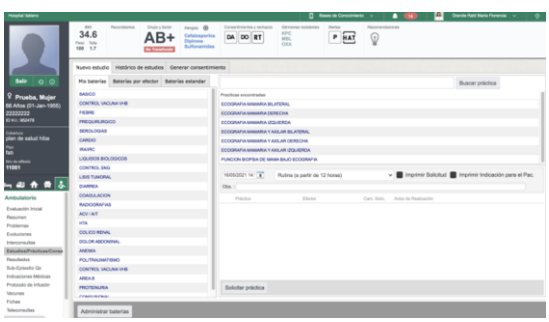
Results

CPOE order sets

The Department of Health Informatics of the HIBA is in charge of the design, development, implementation and maintenance of almost all systems, including the EHR and the PHR, as well as the administrative systems [10].

We implemented a CPOE system into the EHR, ongoing since 2012, that allows physicians to search for studies and practices (pre defined concepts), which returns results related to the free text entered. The resulting CPOE system is presented in **Figure 1**.

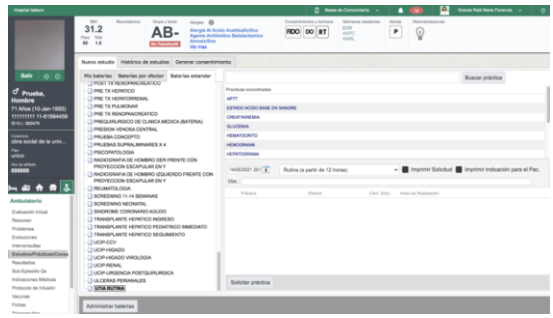
Figure 1. *CPOE searcher as an example of functionality, and results about "breast ultrasound".*



Previous studies suggested that computerized medical implementation improves decision-making and patient management [11, 12]. That's why then, we included electronic order sets (EOSs).

By classic definition, an order set allows you to request all the practices or studies that it contains. However, in our case, the user (physicians) must select what they really want by clicking the one by one from a menu of relevant orders grouped by clinical purpose. One additional functionality is to allow individual clinicians to develop their own “private” order sets that they can use for their patients. The resulting EOSs prototype is presented in **Figure 2**.

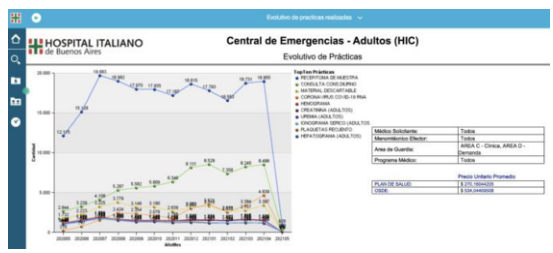
Figure 2. *Laboratory orders with default selections for ease of entry.*



Costs dashboard in the ED

Due to the significant and excessive use of medical tests with insufficient evidence of effectiveness, resulting in unnecessary and costly expenditure of resources without improving clinical outcomes, we decided to develop a costs dashboard that showed us local and real-time data. The resulting prototype dashboard is presented in **Figure 3**.

Figure 3. *Dashboard which shows the 10 most requested medical tests in the last year (from May 2020 to May 2021).*



We have implemented it since December 2019, and allowed us to detect the top 10 most widely used and the top 10 most expensive tests. In the graph (proxy as evaluation), we noticed that the labs seemed to continually increase in every consultation.

Trends of costs in the ED

During the study period a total of 27,671 consults were admitted at the ED, corresponding to 20,863 patients. Most of them were triggered in areas of low and moderate complexity: 14,046 (50.86%) and 5,393 (19.48%) respectively. Regarding the condition at discharge: 8.92% were hospitalized (2,471) and 3.50% (969) were Left Without Being Seen (LWBS: defined as a patient encounter that ended with the patient leaving the healthcare setting before the patient could be seen by a certified physician).

We explored some baseline characteristics related to patients shown in **Table 1** and other outcomes related to costs trends shown in **Table 2**. As can be seen and consistent with our hypothesis, 27% of the consultations have at least one item of laboratory practice, with a median of 9 items, and the laboratory test represents more than 80% of the consultation costs.

Table 1. *Baseline characteristics and metrics of costs*

	January and February 2020 (n: 19,439)
Baseline characteristics	
Number of patients	15,444
Institutional health plan	62.14% (12,080)
Female sex	60.19% (11,700)
Age, in years **	53.23 (SD 20.70)
Primary outcomes	
Total cost of consult, in pesos$ *	507 (IQR 1,115)
At least one item of laboratory test	26.98% (5,246)
Number of items *	9 (4-12)
Cost of laboratory *	880 (563-1410)
At least one imaging test	24.69% (4,799)
Number of items *	2 (1-2)
At least one radiography	14.09% (2,738)
Number of items *	2 (2-2)

* Median (percentil25-percentil75)
** Mean (standard deviation)
$ pesos = currency of Argentina

Table 2. *Costs metrics and trends in ED, per consult*

	1-15 January 2020	16-31 January 2020	1-15 February 2020	16-29 February 2020
Total Cost, in pesos$*	1881.39	1835.69	2047.49	1966.58
Cost of laboratory test, in pesos$*	1590.49	1516.23	1586.89	1619.03
At least one item of laboratory test, in %	27.04	27.36	27.54	25.94
% of cost related to laboratory test	84.53	82.59	77.50	82.32

* Median (interquartile range)
$ pesos = currency of Argentina

Discussion

In this study, we attempted to describe our CPOE system for order sets in ED settings, to explore an economic evaluation of metrics as detailed cost components, and to explore the overall effect that might be essential in EHR for rethinking effective ways to eliminate wastes and inefficiencies. We found that 27% of the consultations have at least one item of laboratory practice, with a median of 9 items, and this represents more than 80% of the consultation costs.

Our findings suggest that there is a significant and excessive use of medical tests in ED, which could entail a potential waste of unnecessary and expensive resources [13]. These results are relevant because healthcare organizations must collaborate to find effective ways to high burden of costs in order to eliminate wastes and inefficiencies, while improving clinical outcomes for patients. Along with human suffering, COVID-19 also threatens the sustainability of health systems, and the ongoing costs of the pandemic combined with the impending financial crisis will inevitably mean having to do more with less [14]. Additionally, patients can suffer direct (e.g., medication side effects, radiation exposure) and indirect (e.g., impact on caregivers) harm from overuse of tests and treatment protocols.

While EHR order sets can save time and improve processes of care, it remains less clear that EHR order sets have shown definite patient outcome benefits [15]. There are controversies surrounding use of order sets for clinical decision support in CPOE from a long time ago [16].

Previous studies demonstrate that it was primarily a method to improve patient safety by avoiding medication errors; achieved through forcing functions that alert health care providers to potential medication cross-reactions or allergy risks [17], and to evidence-based clinical decision rules that may favour particular medications or approaches. Nevertheless, when considered as part of a framework of technical, clinical, and organizational components of the Emergency Department (ED), the evidence base is neither consistent nor comprehensive. CPOE was associated with an increase in time spent on computers (up to 16.2% for nurses and 11.3% for physicians), with no significant change in time spent on patient care [18].

Even when there are tangible benefits associated with CPOE, there were no studies that measured decision support systems and its effect on patient flow/clinical work in the ED environment [19]. Its effect on ED flow remains undefined, due the potential detrimental effects to patient safety of CPOE implementation outweigh its benefits [20].

Unnecessary healthcare utilization, non-adherence to current clinical guidelines, or insufficient personalized care are perpetual challenges and remain potential major cost-drivers for healthcare systems around the world [7].

Evaluating the economic impact of EHR-based CDSS interventions and their potential to increase value in healthcare remains a significant challenge. A recent study found that 22 studies report cost savings, most of them do not include developing or maintaining costs [7]. Therefore, they could not draw a sound correlation between vendor-purchased or home-grown systems' costs to their economic benefit.

Another economic challenge to consider is CPOE systems with default lists or opt-out options of orderable tests as well as predefined order sets. The automation of orders through such order sets or joint-order options could ultimately lead to an increase in costs [21]. For example, the rate of unnecessary laboratory tests can increase when healthcare professionals tend to accept the whole order set rather than de-selecting single order items [22]. The removal of an order option ultimately resulted in fewer laboratory tests and reduced healthcare expenditure in all studies [23, 24]. However, doing their own "private" order sets potentially removes the evidence-based nature of such order sets and can make it difficult for CPOE clinician-users to "do the right thing," based on evidence-based order sets.

Ongoing studies examining the efficacy of CPOE are critical, but they are limited by the inevitable multitude of factors affecting productivity in the ED [5]. The analysis identified increased safety profiles associated with CPOE and increased time spent on computers, but nothing regarding flow optimization in the ED [2].

Many factors impact utilization including: the health and socio-economic status of a population; engagement in high risk behaviour; government policy; the supply and demand for services, equipment and varied care providers. Health care spending has reached epic proportions globally. We think that it is time to use quality improvement strategies including lean methodology for identification and removal of waste within healthcare processes. A future line of study will be to deactivate the CPOE order set for the ED, with the intention of exploring whether this is associated with rethinking the individual clinical context of each person and, consequently, allows requesting fewer unnecessary practices.

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