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Clinical Decision Support System for PIM in Elderly Patients: Implementation and Initial Evaluation in Ambulatory Care

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Abstract. The high prevalence of PIMs in elderly is a major healthcare concern and indicates the need for medication monitoring systems. Most PIM CDSS have shown positive effects respecting PIM prescription but these results were more consistently in hospital settings compared with ambulatory care. We describe the post-implementation evaluation of a PIM CDSS for general practitioners (GP) in the ambulatory setting and explore GP interactions with the PIM alerts. The CDSS generated 3218 unique alerts and involved 2863 elderly patients. Benzodiazepines was the drug with the most alerts triggered. Only 129 (4 %) were opened by GP during patient appointments. We need to develop an understanding of how alerts should be designed and display information to support the workflow of general practitioners. Pos-implementation evaluations are the key of CDSS improvements.

Keywords. Clinical Decision Support systems, Potentially Inappropriate Medication, Elderly, Electronic Health Records.

1. Introduction

The world's population is rapidly aging and is projected to double nearly 1.5 billion in 2050 [1]. The increase in multimorbidity results in a high use of medications in the elderly where potentially inappropriate medications (PIM) become more prevalent [2]. PIM may be defined as medications which result in a significant risk of adverse health outcomes, are associated with adverse drug events, morbidity, functional decline, and mortality [3].

The high prevalence of PIM is a major healthcare concern and indicates the need for medication monitoring systems. To address this issue, many guidelines have been developed. One example is Beers Criteria, an important tool for physicians in medication management in elderly [4].

Reducing PIM has been challenging and many interventions were implemented in this matter (educational assessment, restrictive prescriptions, etc). The benefits of Clinical Decision Support Systems (CDSS) regarding medical error and health outcomes are widely known [5]. Most PIM CDSS have shown positive effects respecting PIM

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prescription, but these results were more consistently in hospital settings compared with ambulatory care [6]. This gap between settings reveals the need to investigate ambulatory care.

The goal of this study is to describe the post-implementation evaluation of a PIM CDSS for general practitioners (GP) in the ambulatory setting and explore GP interactions with the PIM alerts.

2. Methods

2.1. Setting

Our study took place at Hospital Italiano de Buenos Aires (HIBA), a community-based tertiary care hospital located in Buenos Aires, Argentina. HIBA also has outpatient clinics in its network. It is a HIMSS Level 7+ organization with an in-house developed health information system which includes clinical and administrative data. It features a web-based, problem-oriented EHR; a terminology server referenced to SNOMED CT; and an integrated personal health record (PHR). HIBA has its health insurance called Plan de Salud (PS) with over 150,000 affiliates, 23 % of them being elderly.

2.2. Design and data collection

We conducted a cross sectional study between August and December 2021. We analyzed all PIM CDSS alerts triggered in EHR during the study period.

Regarding data collection, we used secondary databases with clinical and administrative data sets containing different variables of interest related with PIM CDSS: PIM type, patient's sex and age and GP interactions with the alert (click-through rate).

2.3. PIM CDSS

A PIM Clinical decision tool was designed by an interdisciplinary team of health informatics specialists and General Practitioners to address the need for identification of elderly outpatients who purchased PIM at the HIBA pharmacy.

A highlighted icon in the header of the patient's EHR shows that the clinical alert has been triggered, and clicking it displays the alert in detail (Figure 1).

The alert triggers when the following criteria are met: 1) Patient is over 64 years old, 2) PS affiliated, 3) Patient has a GP assigned, 4) PIM purchase in a period no longer than 92 days prior, 5) Scheduled appointment with GP (face-to-face or teleconsultation). Patients without appointments or hospitalized were excluded.

Three sets of PIM were defined based on the Beers criteria and on data collected in previous studies in HIBA. The three most common drug classes prescribed in the elderly were selected: Benzodiazepines (BZDs), Proton Pump Inhibitors (PPIs) and Non-steroidal anti-inflammatories (NSAIDs) [7].

The CDSS alert provides information about PIM purchase (date and PIM type), includes links to educational information as Beers Criteria 2019, and suggests prescription revision. Also includes clinical algorithms regarding PIM to guide GP. It has some features like the 'Go to Prescription module' button which automatically

redirects to the EHR prescription module, “Suggestions” and “Don’t show again” which deactivates the alert for a period of 92 days.

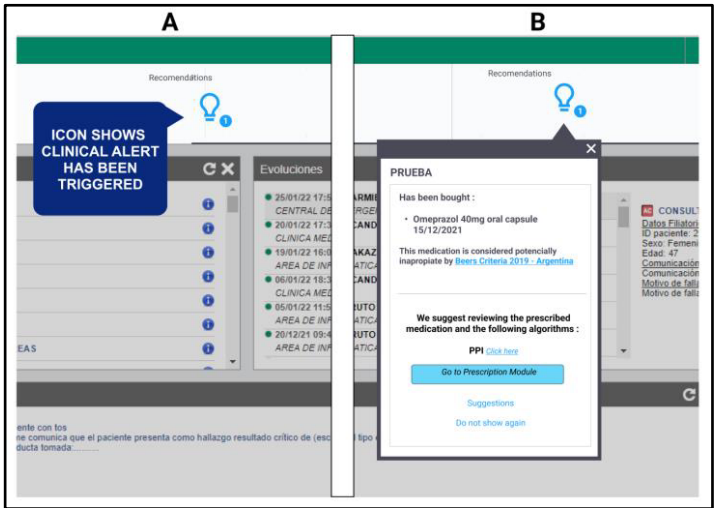

Figure 1. PIM CDSS Alert

Fast Healthcare Interoperability Resources (FHIR), CDS-Hooks and SNOMED CT standards were used for the design and development of this tool.

2.4. Ethical considerations

The study was performed in full agreement with current national and international ethical regulations. Was approved by the institutional ethics committee (CEPI # 6174).

3. Results

The CDSS generated 3218 unique alerts during the study period. It involved 2863 elderly patients with a mean age of 78 (DS 7.6). Female sex was predominant with 74.85 % (2143). Almost half of the patients triggered the alert more than twice for different drug purchases during this period.

Regarding PIM, 52.37 % (2280) belonged to BZDs, 40.20 % (1750) PPIs and only 7.05 % (307) were NSAIDs. Analyzing the BZDs group, it was composed mostly of Clonazepam in 35% (820) and Alprazolam in 33.64% (768). The rest was composed of a variable proportion of Lorazepam, Bromazepam and Midazolam. Respecting PPIs, Omeprazol and Esomeprazol were the most frequent (48% , 23.45%). Finally, half of NSAIDs were Diclofenac (51.79 %) followed by Ibuprofen (24.75%) and Ketorolac (28.89%).

Among 3218 alerts triggered and available in the EHR as a highlighted lightbulb Icon, only 129 (4 %) were opened by GP during patient appointments. Exploring actions performed in the alert by users, suggestions and prescription module’s buttons had a click-through rate (CTR) of 8.95 % and 7.25% respectively. We found a low CRT in

educational links to see information about PPIs and NSAIDs. The actions most frequently taken were opening and closing the alert without any interaction. (Table 1).

Table 1. General Practitioners clicks interaction in alert features

Action Description	Alerts opened (129) Total Clicks = 151	Alerts Opened (75) In - person visit (Clicks = 117)	Alerts Opened (54) Teleconsultation (Clicks = 34)
Go to prescription module button	5.96 % (9)	6.83% (8)	2.94% (1)
Suggestion button	7.28% (11)	3.41% (4)	8.82% (3)
Do not show again button	3.31 % (5)	3.41% (4)	2.94% (1)
Educational links about PIM			
PPIs information link	3.97 % (6)	3.41% (4)	5.88% (2)
NSAIDs information link	0.66% (1)	0.85% (1)	-

4. Discussion

In this study, we attempted to evaluate a CDSS which identifies elderly patients with PIM purchased, with the aim of suggesting to general practitioners to do an evaluation of PIM prescription.

Potentially inappropriate medications among older patients have a high prevalence reported by Storms et al. [8]. The amount of alerts triggered in our findings may be an indicator about how much elderly population consumed PIM, regardless of the potential adverse effects [9]. Regarding PIM, our results showed a low percent of NSAIDs compared to what is reported in literature [10]. This situation can be explained by the fact that in Argentina this type of drug is very accessible and it is sold in many shops without prescription.

General practitioners overrode 96% of PIM alerts. Very few GP clicked on educational links and followed the alert's suggestion. This finding is consistent with high override rates reported in the literature [11]. Many factors could be involved in this override rate like alert design and care setting. The outpatient care workflow is non-identical to a hospitalized environment in which more of the CDSS evaluation studies focus [12]. Qualitative research is needed to better understand how physicians interact with decision support at the point of care and why they ignored it. We believe that override rate monitoring should be a standard practice if a CDSS is implemented.

This study has some limitations. Our CDSS is based only on a single clinical guideline (Beers Criteria) and elderly patients are multi-morbid patients who require the integration of multiple clínical practice guidelines for a better approach [13]. Also, the older adults who triggered the alert may not be representative of the general older adult population in Argentina. Respecting PIM, we evaluated only 3 sets of medicines (BZDs, PPIs and NSAIDs) which limited the fully comprehension of PIM purchased in elderly.

As a future line of work, we will redesign alert's features and visualization display with the intention to explore the effect in general practitioners's response.

5. Conclusion

PIM still are a major health concern in elderly as our study showed in the amount of alerts triggered. More research is necessary, applying a usability approach, to explore general practitioners needs and patterns of use for a full adoption of PIM CDSS.

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