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Improving Waiting Time for Chemotherapy with Ahead-of-Time Drug Preparation

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Abstract. Waiting time for chemotherapy infusion is a fundamental factor to measure quality of care. It has been shown that a prolonged waiting time is related to a higher incidence of anticipatory nausea and poor patient adherence to scheduled appointments and recommended oncology treatment programs. Some chemotherapy regimens can be prepared hours ahead-of-time, due to long stability. We aimed to study the effect of an informatic-led workflow redesign intervention, facilitating workflow changes in the Oncology Pharmacy, on patient waiting time. This intervention included changes on EHR processes and the chemotherapy CPOE. Their main effect was allowing ahead-of-time preparation of selected chemotherapy regimes. We conducted a cross sectional study, comparing waiting times pre and post intervention periods. A total of 4600 programmed chemotherapy episodes were included. We found a 26.5 % decrease in the mean wait time in the post intervention period ($p > 0.02$). We were able to show a decrease in waiting time and a measurable impact of the intervention. This evaluation produced valuable and actionable data for Oncology units and adds a valuable, Latin American experience to the literature.

Keywords. Waiting time, chemotherapy, oncology, quality improvement, pharmacy workflow

1. Introduction

One of the most commonly used treatments in cancer is chemotherapy infusion, mostly being performed in the outpatient setting [1]. This makes oncology patients visit the hospital more frequently compared to other treatments. In many cases they behave clinically as immunocompromised, being more susceptible to nosocomial infections [2].

Waiting time for chemotherapy infusion is a fundamental factor to measure quality of care [3]. It is a reflection of the efficiency of institutional processes. Long check-ins, delays in laboratory results, the time required for patient evaluation, adequacy of nursing staffing resources and physical space limitations in relation to the number of patients, and delays at preparation of chemotherapeutic drugs are principal factors contributing to the increase in waiting time [4].

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It has been shown that a prolonged waiting time is related to a higher incidence of anticipatory nausea and poor patient adherence to scheduled appointments and recommended oncology treatment programs [5].

Oncological drugs have different stabilities, some of them can be prepared hours before their administration [6]. This property makes it feasible for the Oncology Pharmacy to prepare the medication the day before administration.

For this purpose, the Hospital Italiano de Buenos Aires has redesigned the chemotherapy infusion workflow. Following these changes, the oncologist performs the routine check-up using Telemedicine, reviews lab results on the EHR, and prescribes the chemotherapy regimen the day before the patient's scheduled appointment. After prescription, the oncology pharmacy reviews and prepares the ordered drugs, leaving them ready for when the patient arrives the next day. Only selected regimens may be prepared in advance, based on drug stability and shelf-life.

These changes required some adaptations in the admission, discharge, and transfer (ADT) and HCE systems. Admission staff could now open the chemotherapy episode without the patient present, leaving the final admission for the next day. Virtual sectors were implemented to organize and identify these patients. On the other hand, this enabled in-advance prescription in the EHR, triggering the oncology pharmacy workflow.

This research aims to evaluate if there were any modifications on outpatient chemotherapy waiting times as a result of the workflow redesign intervention.

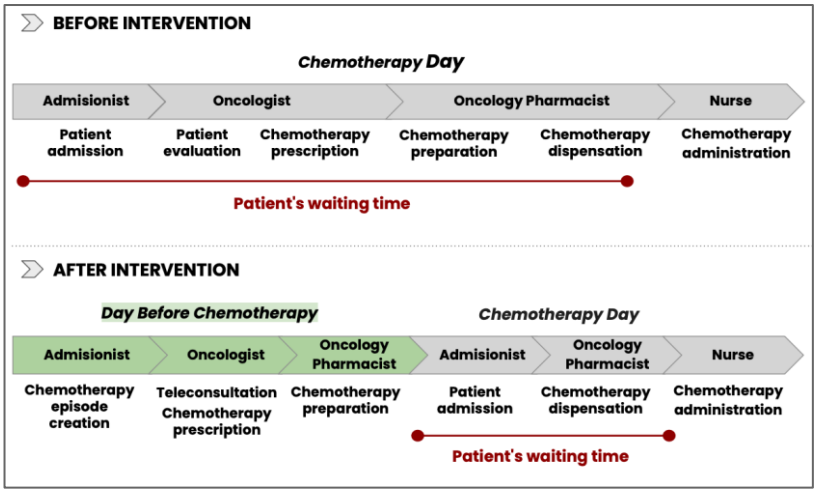

Figure 1. Chemotherapy workflow before and after intervention.

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 is a HIMSS Level 7+ organization with an in-house developed health information system [7]. Included in its Electronic Health Record (EHR) is a specialized CPOE for chemotherapy regimens

prescription and administration [8]. Hospital Italiano has its own health insurance called Plan de Salud (PS) with over 150,000 affiliates.

Hospital Italiano is equipped with 25 outpatient chemotherapy stations, performing more than 800 treatment administrations monthly. Chemotherapy drugs are prepared by a specialized pharmacy unit.

2.2. Design, participants and data collection

We conducted a retrospective observational, descriptive and analytical cross-sectional study, comparing pre-intervention (April - October 2020) and post-intervention (November 2020 - March 2021) historical periods.

Eligible outpatient chemotherapy episodes were included if they met the following criteria: belonged to adults older than 18 years of age, affiliated to HIBA 'Plan de Salud' and the programmed chemotherapy regimen was suitable for ahead-of-time preparation (considering drug stability, safety and cost).

We defined waiting time as the time difference between the patient arriving at the chemotherapy sector and the pharmacy sending the prepared medication for infusion, as registered in the EHR.

All clinical and administrative information is collected and stored in a single centralized computerized data repository accessible through the EHR, which was our key data source for the collection of variables necessary for the purposes of the project.

For this work, we carried out a convenience sampling (non-probabilistic and non-random), since all the episodes obtained from the database query were considered, delimited by the selection criteria.

The research project was approved by the institutional ethics committee (CEPI # 6340 PRIISA 6853). The study was performed in full agreement with current national and international ethical regulations.

3. Results

A total of 2500 programmed chemotherapy episodes were included in the pre-intervention period and 2100 after intervention.The patient's median age was 72 (IQR 15) and 69 (IQR 17) for pre and post period. Female sex was predominant in both groups (Table 1).

We found an improvement in waiting times in the post intervention period. There was a 26.5 % decrease in the mean wait time (79 *v* 58 minutes). Regarding chemotherapy regimens, the most frequent were: Paclitaxel (18%), Carboplatin (15%), Gemcitabine (12%), Pemetrexed (9%) and Docetaxel (6%).

Table 1. Baseline characteristics and waiting times.

	Pre-Intervention (N=2500)	**Post-Intervention (N=2100)**	**Percent decrease**	**p value**
Baseline characteristics				
Patients	504	410	-	-
Female sex	68.83% (346)	65% (266)	-	0.52
Age, in years*	72 (IQR 15)	69 (IQR 17)	-	0.07

Waiting times (minutes)*	72 (SD 32)	58 (SD 25)	26.5%	<0.02

*Median (Interquartile Range)
**Mean (Standard Deviation)

4. Discussion

Reducing waiting times for chemotherapy infusion is a topic present in the recent literature. We were able to find experiences with similar goals published. As an example, at the Sylvester Comprehensive Cancer Center (Miami, FL) improvements have been applied in the workflow. The objective of his work was to reduce the times of laboratory results for patients who needed to perform these tests on the same day of the infusion, consequently decreasing the waiting time until receiving treatment [9]. In a different experience, the University of Texas 'MD Anderson Cancer Center' launched a digital dashboard for Pharmacy. This information management tool displays real-time data of a patient's vital signs, determined if they are in condition for treatment, allowing the pharmacy to decide when to prepare short-term or high-cost drugs shortly after the patient's arrival [10]. This work also reflects on the high importance of the drug preparation process in patient waiting times. However, at regional and local level there are no studies that have proposed alternatives using informatics applications to reduce the waiting time of oncology patients. In that context, we believe this present work provides valuable experience outside of the United States, specifically Latin America, in a highly relevant and current area of research. This experience also covers a specific intervention, involving the pharmacy workflow, one that is almost not explored in the literature.

Through this study we were able to show a measurable impact of the intervention. These results are of high consequence both on the oncology patient treatment experience, as well as the hospital processes. Both the intervention and its evaluation were of low costs for HIBA, showing that expensive interventions are not always needed to significantly improve workflow. Reduction in waiting times have been related to better satisfaction and perceived quality [11], giving a valuable context to this work. Furthermore, this evaluation produced valuable and actionable data for our pharmacy and oncology units, key partners for a successful implementation.

This study has some limitations. This is a single-center study, our experience may not translate directly to other institutions. Furthermore, the implementation was carried out during the COVID-19 pandemic. While the project was planned before COVID, the pandemic implied several changes in workflow and staffing. Results should be re-evaluated once the situation normalizes, although non-patient facing areas, such as the Oncology Pharmacy, were less affected. Finally, time data was obtained through EHR records. While this indirect method is very cost efficient, it may be less reliable than in-situ measurement or shadowing. However, we aimed to use the most reliable records possible, and data was analyzed to exclude inconsistencies.

As a future line of work, we intend to measure satisfaction on Pharmacy users, aiming particularly at the improvements in workflow facilitated by the intervention. While we may infer higher patient satisfaction with lower waiting times, we also aim to directly measure this in a future study. Lastly, improvements in workflow may have a

sizable impact on costs, productivity, and possible losses on discarded medication, a line especially considered for future research.

5. Conclusions

In this work, we aimed to study the effect of an informatic-led workflow redesign intervention, facilitating workflow changes in the Oncology Pharmacy and on patient waiting time. This intervention included changes on EHR processes and the chemotherapy CPOE. Their main effect was allowing ahead-of-time preparation of selected chemotherapy regimens. We were able to show a significant decrease in waiting time. Both for the selected regimens, as well as for all programmed infusions.

This paper adds a valuable, Latin American experience to the literature. Through this low-cost intervention we were able to achieve a positive measurable impact on the patient. This could improve other treatment clinical outcomes, such as the prevalence of anticipatory nausea. Effects on Pharmacy staff satisfaction and productivity still needs to be studied fully.

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