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Original Research

Analysis of the Implementation of the "Gass Track Chemotherapy Program" As an Alternative Solution to Improve Oncology Services

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ABSTRACT

Background: Timeliness in chemotherapy scheduling is essential in oncology practice. In Dr. Kariadi Hospital, increasing patient volume led to long waiting lists and treatment delays averaging 7 days. To address this issue, an innovation called "Gass Track," adapted from the fast-track system, was developed to accelerate chemotherapy services. **Objective:** This study aimed to analyze the implementation of the Gass Track chemotherapy program as an alternative solution to improve service efficiency and timeliness in oncology care at Dr. Kariadi Hospital, Semarang, Indonesia. **Methods:** This pre-post observational study used retrospective secondary data from January 2023 to June 2024, conducted at the Oncology Installation of Dr. Kariadi Hospital, Semarang. Individual patient-level chemotherapy delay data were extracted from medical records. Data were analyzed to compare chemotherapy delay distributions, patient flow, and service throughput between the pre-implementation (January May 2023) and post-implementation (June 2023 June 2024) periods. **Results:** A total of 8,479 programmed chemotherapy patients were recorded. Of 6,273 post-implementation patients, 509 (8.1%) received care via Gass Track. The median chemotherapy delay decreased from 7 days (IQR: 6 8) pre-implementation to 4 days (IQR: 3 5) post-implementation. A Mann-Whitney U test on individual patient-level data confirmed the reduction was statistically significant ($U = 12{,}988{,}890$; $p < 0.001$; rank-biserial $r = 0.877$, indicating a large effect). Monthly chemotherapy throughput increased by approximately 9.4% (from 441.2 to 482.5 patients/month). **Conclusion:** Gass Track improved patient flow, reduced delays, and supported timeliness in oncology chemotherapy services without requiring additional resources.

Keywords: oncology service; chemotherapy; gass track; fast track; hospital innovation

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1. INTRODUCTION

Timeliness in chemotherapy administration is a critical indicator of quality in oncology services. Delays in chemotherapy delivery have been shown to negatively affect clinical outcomes, increase patient anxiety, disrupt treatment continuity, and reduce overall patient satisfaction. Hanna et al. (2020) demonstrated in a landmark systematic review and meta-analysis of 1,272,681 patients that even a four-week treatment delay was associated with significantly increased mortality across multiple cancer types. For systemic chemotherapy indications specifically, hazard ratios for overall survival ranged from 1.01 to 1.28 per four-week delay, with significant associations for breast adjuvant (HR = 1.09), neoadjuvant (HR = 1.28), and colon/rectal adjuvant chemotherapy (HR = 1.13) (Hanna et al., 2020).

In ambulatory oncology settings, chemotherapy treatment delays arise from multiple interdependent causes. Lafferty et al. (2020) conducted a multisite qualitative investigation across eight ambulatory oncology practices in the United States, identifying four primary systemic themes responsible for treatment delays: discrepancies in care plans and missing physician orders, uncommunicated day-of-treatment order changes, orders not pre-signed by physicians, and delays in laboratory testing processes. These findings underscore that workflow inefficiencies not clinical complexity alone are responsible for a substantial proportion of preventable chemotherapy delays (Lafferty et al., 2020).

Hospital service delays are not limited to clinical processes. In hospital-based oncology care, delays commonly arise from limited bed availability, inefficient scheduling systems, and prolonged pharmaceutical preparation processes. Jen et al. (2023) demonstrated that a design thinking approach in a Singapore tertiary cancer centre specifically targeting pharmacy preparation and morning scheduling achieved a statistically significant reduction in chemotherapy wait times. Similarly, Soh et al. (2014) showed that pre-preparation of elective chemotherapy regimens one day before appointment significantly reduced overall wait time, identifying late prescription submission and long pharmacy processing times as the principal contributors to delay.

At Dr. Kariadi Hospital, the increasing volume of oncology patients resulted in prolonged waiting lists for programmed chemotherapy, with delays averaging up to seven days. Prior to 2020, chemotherapy services were conducted through a conventional system in which patients underwent outpatient assessment and subsequently waited for inpatient admission based on bed availability. This fragmented workflow often led to treatment postponements and inefficiencies in patient flow.

Unlike high-income countries with private insurance-based oncology systems, Indonesia operates under a universal national health insurance scheme managed by the Badan Penyelenggara Jaminan Sosial (BPJS) Kesehatan. Since its launch in 2014, BPJS Kesehatan has covered approximately 82.3% of Indonesia's 270 million population (Schaefers et al., 2022). Chemotherapy services under BPJS require strict administrative verification, adherence to national formularies, and hierarchical referral compliance. The 2020 BPJS Kesehatan report indicated that total claims for cancer treatment amounted to IDR 3.1 trillion, reflecting substantial and growing demand (Maulana et al., 2022). As a result, workflow flexibility is limited by insurance authorization processes and government hospital administrative regulations.

These structural characteristics create unique operational challenges for fast-track chemotherapy implementation compared to settings with more autonomous hospital systems.

Inequities in cancer care outcomes under the BPJS system have also been documented. Disparities in outcomes by membership type including length of hospital stay and claim costs were identified in a large-scale cross-sectional analysis of BPJS inpatient cancer claims from 2017 to 2022, further highlighting systemic pressures on oncology service delivery in Indonesia (Maulana et al., 2022). Therefore, workflow redesign in the Indonesian context requires integration not only of clinical coordination but also administrative and pharmaceutical synchronization.

The establishment of the Integrated Oncology Building enabled the adoption of a fast-track chemotherapy model, allowing patients to be admitted one day prior to chemotherapy administration. Although this approach improved coordination between outpatient and inpatient services, it still required overnight hospitalization solely to wait for chemotherapy drug preparation. These residual inefficiencies align with international evidence that fast-track systems require ongoing optimization of interdisciplinary communication, pharmaceutical pre-preparation, and patient scheduling to realize their full potential (Jen et al., 2023; Lafferty et al., 2020).

To address these inefficiencies, an innovative service model known as the Gass Track chemotherapy program was developed. This system enables same-day patient admission, pharmaceutical preparation, and chemotherapy administration through coordinated interdisciplinary collaboration involving oncologists, oncology nurses, inpatient admission services, and hospital pharmacy units. The ten-year cancer fast-track programme (CFP) reported by Chirivella et al. (2021) in a Spanish health department demonstrated that connecting primary care with oncology through streamlined referral and diagnostic acceleration can significantly shorten the interval from symptom presentation to treatment initiation a model conceptually aligned with the Gass Track approach of reducing pre-treatment system delays.

Despite growing international evidence supporting fast-track and clinical pathway innovations in oncology services, empirical reports on chemotherapy scheduling innovations within Indonesian hospital systems remain limited. Therefore, this study aimed to analyze the implementation of the Gass Track chemotherapy program as an alternative solution to improve service efficiency and timeliness in oncology care at Dr. Kariadi Hospital.

2. METHODS

This study employed a pre-post observational design to evaluate the feasibility and efficiency of the Gass Track chemotherapy program compared with the previously implemented fast-track system in the Oncology Unit of Dr. Kariadi Hospital, Semarang, Indonesia. The analysis was based on retrospective secondary data collected between January 2023 and June 2024. The pre-implementation phase covered January to May 2023, and the post-implementation phase covered June 2023 to June 2024.

The study population included all programmed chemotherapy patients treated during the study period. A total sampling design was used, whereby all eligible patients were included. Between June 2023 and June 2024, 6,273 programmed chemotherapy patients were recorded, of whom 509 patients (8.1%) received chemotherapy using the Gass Track system.

2.1 Inclusion and Exclusion Criteria

Inclusion criteria comprised: patients undergoing programmed chemotherapy, patients treated under Gass Track protocol, completed chemotherapy cycle, and complete medical record documentation including individual-level delay data. Exclusion criteria comprised: cancelled chemotherapy due to medical or non-medical reasons and chemotherapy outside predefined protocols.

Not all programmed chemotherapy patients were eligible for the Gass Track pathway. Eligibility was determined by the attending physician based on clinical stability, treatment protocol, and safety considerations. Patients requiring intensive pre-chemotherapy monitoring, complex hydration regimens, non-standard protocols, or those experiencing medical or non-medical cancellations were excluded from the accelerated pathway. In addition, operational factors such as bed availability, pharmacy processing capacity, and interdepartmental coordination limited full-scale implementation.

2.2 Interventions/Procedures

Before implementation, the fast-track model required overnight admission prior to chemotherapy infusion to accommodate pharmaceutical preparation. The Gass Track model redesigned this workflow to allow same-day admission, preparation, and scheduling without additional overnight stay. The redesigned process involved coordinated scheduling and communication among the attending physicians, outpatient and inpatient

nursing units, the patient admission office, and the pharmacy department. Patients were pre-verified during the outpatient visit, and chemotherapy orders were prepared in advance. Upon admission, the pharmacy prepared the chemotherapy drugs immediately, and the treatment room was notified once the medication was ready.

This approach is consistent with evidence from quality improvement initiatives in ambulatory oncology settings showing that preparation of chemotherapy prescriptions, including pharmacy review and pre-approval processes, is an effective strategy to reduce treatment day wait times (Blackmer et al., 2021; Jen et al., 2023).

2.3 Pilot Study

A pilot study involving 22 patients was conducted in April 2023 to assess workflow feasibility, demonstrating an average pharmaceutical preparation time of 90 to 120 minutes before infusion. These 22 pilot patients were not included in the main study dataset, as the pilot phase was designed solely for process validation prior to formal implementation commencing in June 2023. All data presented in Tables 1 and 3 reflect only the formal study period (January 2023 to June 2024), excluding the pilot cohort.

2.4 Data Collection

Individual-level patient data were extracted from electronic medical records. For each patient, the following variables were collected: total scheduled chemotherapy patients, number of Gass Track patients, individual chemotherapy delay (days, defined as the difference between the scheduled and actual chemotherapy administration date), on-time versus delayed chemotherapy classification, and cumulative monthly flow. Pre-intervention baseline: January May 2023. Post-intervention implementation: June 2023 to June 2024.

2.5 Statistical Analysis

Data were analyzed at the individual patient level. Categorical data were presented as frequencies and percentages. Continuous data were reported as median with interquartile range (IQR) and mean. Chemotherapy delay was measured in days per patient as the primary outcome variable. Normality testing using the Kolmogorov-Smirnov test indicated that the delay data were not normally distributed ($p < 0.05$ for both periods). Therefore, a non-parametric Mann-Whitney U test was applied to compare individual patient-level chemotherapy delay between the pre-implementation period (January May 2023; n = 2,206 patients) and the post-implementation period (June 2023 June 2024; n = 6,273 patients).

Whitney U test, providing a standardized, scale-independent estimate of the magnitude of group differences (Morrill et al., 2022). A p-value < 0.05 was considered statistically significant with a 95% confidence level. All analyses were performed at the individual patient level, with the total sample comprising n = 8,479 patients.

2.6 Ethics

This study used retrospective secondary non-identifiable data and did not require ethical approval or informed consent based on institutional regulations.

3. RESULTS

A total of 8,479 programmed chemotherapy patients were recorded during the study period (January 2023 to June 2024). The implementation of the Gass Track system improved timeliness and throughput compared to the baseline.

3.1 Baseline

During the pre-implementation period (January May 2023), a total of 2,206 patients received programmed chemotherapy through the conventional fast-track pathway. All patients experienced chemotherapy delays with a median of 7 days (IQR: 6 8 days; mean: 7.0 days) due to bed allocation constraints and pharmaceutical preparation requirements. No patients received the Gass Track protocol during this period.

Table 1. Baseline Data Before Gass Track (Jan May 2023)

Indicator	Jan	Feb	Mar	Apr	May
Gass Track Patients	0	0	0	0	0
Fast Track Patients	488	376	496	407	439
Total Programmed Chemotherapy	488	376	496	407	439
Mean Delay (days)	7.0	7.1	6.9	7.0	7.0
Median Delay (IQR)	7 (6–8)	7 (6–8)	7 (6–8)	7 (6–8)	7 (6–8)

**IQR = Interquartile Range. Delay is defined as the difference between the scheduled and actual chemotherapy administration date per individual patient. No Gass Track patients were treated during this period.*

Table 1 shows that throughout the pre-implementation period, the total monthly chemotherapy volume ranged from 376 to 496 patients, with a consistently stable median delay of 7 days (IQR: 6 8) across all five months. These figures confirm a uniform baseline delay pattern before any intervention, supporting the comparability of pre- and post-implementation data.

3.2 Post-Implementation

Between June 2023 and June 2024, a total of 6,273 programmed chemotherapy cycles were recorded. Of those, 509 patients (8.1%) were treated under Gass Track. The median chemotherapy delay decreased from 7 days (IQR: 6 8) to 4 days (IQR: 3 5), with a mean delay of 4.0 days. This improvement was sustained consistently across all 13 months of the post-implementation period.

Table 2. Implementation Data (Jun 2023 Jun 2024)

Indicator	**Jun '23**	**Jul '23**	**Aug '23**	**Sep '23**	**Oct '23**	**Nov '23**	**Dec '23**	**Jan '24**	**Feb '24**	**Mar '24**	**Apr '24**	**May '24**	**Jun '24**
Gass Track Patients	89	70	57	22	15	23	36	37	39	25	37	26	33
Fast Track Patients	374	446	499	458	487	500	483	435	446	438	344	452	402
Total Programmed Chemo	463	516	556	480	502	523	519	472	485	463	381	478	435
Mean Delay (days)	4.1	3.9	4.0	4.1	3.8	4.0	4.0	4.0	4.1	3.9	4.0	3.9	4.0
Median Delay (IQR)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)	4 (3–5)

**IQR = Interquartile Range. Delay values represent individual patient-level data aggregated per month. Table covers both the initial (Jun Dec 2023) and continuation (Jan Jun 2024) phases of implementation.*

As shown in Table 2, Gass Track enrollment commenced in June 2023 with 89 patients and was maintained throughout the entire observation period, with monthly enrollment ranging from 15 to 89 patients. The median chemotherapy delay remained consistently at 4 days (IQR: 3 5) across all 13 months, demonstrating the stability and sustained impact of the redesigned workflow. Total monthly chemotherapy throughput ranged from 381 to 556 patients, reflecting improved service capacity compared to the pre-implementation baseline.

3.3 Cumulative Findings

Across the full post-implementation period (June 2023 to June 2024), the median chemotherapy delay decreased from 7 days (IQR: 6 8) to 4 days (IQR: 3 5). Average monthly chemotherapy throughput increased from 441.2 patients per month (pre-implementation) to 482.5 patients per month (post-implementation), representing a 9.4% increase. This improvement in capacity was achieved without additional financial resources and reflects the workflow optimization enabled by the Gass Track system.

3.4 Statistical Analysis Results

The Mann-Whitney U test was performed on individual patient-level delay data comparing the pre-implementation period (n = 2,206 patients; median = 7 days, IQR: 6 8) and the post-implementation period (n = 6,273 patients; median = 4 days, IQR: 3 5). The result was statistically significant (U = 12,988,890; $p < 0.001$), confirming that the reduction in chemotherapy delay following Gass Track implementation was not due to chance. The rank-biserial correlation of r = 0.877 indicates a large effect size, demonstrating a clinically meaningful and statistically robust reduction in treatment delay.

Table 3. Mann-Whitney U Test Results: Chemotherapy Delay Before vs. After Gass Track Implementation

Parameter	Pre-Implementation (Jan–May 2023) n = 2,206	Post-Implementation (Jun 2023–Jun 2024) n = 6,273	Mann-Whitney U	p-value
Chemotherapy Delay (days)	7 (IQR: 6–8); Mean 7.0	4 (IQR: 3–5); Mean 4.0	12,988,890	< 0.001
Rank-Biserial Correlation (r)	—	—	0.877	—

**Mann-Whitney U test performed on individual patient-level delay data. Rank-biserial correlation r = 0.877 indicates a large effect size. Delay = difference between the scheduled and actual chemotherapy date per patient.*

Table 3 presents the results of the statistical comparison between the two periods. The Mann-Whitney U value of 12,988,890 with $p < 0.001$ confirms that the reduction in delay was highly significant. The rank-biserial correlation of r = 0.877 reflects a large effect size, indicating that the Gass Track intervention produced not only a statistically significant but also a clinically meaningful improvement in chemotherapy timeliness.

4. DISCUSSION

The Gass Track program achieved a statistically significant and clinically meaningful reduction in chemotherapy delay, from a median of 7 days (IQR: 6 8) to 4 days (IQR: 3 5), sustained over 12 months (Mann-Whitney U = 12,988,890; $p < 0.001$; r = 0.877). This large effect size confirms the robustness of the improvement. The clinical relevance of reducing delays is supported by Hanna et al. (2020), who demonstrated that each four-week delay in adjuvant chemotherapy is associated with increased mortality risk across multiple cancer types (HR = 1.09 1.28). Although the delays at Dr. Kariadi Hospital were shorter than those studied in that meta-analysis, the consistent reduction represents a meaningful gain in a resource-limited public hospital context, where system-wide redesign, as emphasized by Morrill et al. (2022), is essential to address multifactorial treatment delays.

The mechanism underlying Gass Track's effectiveness lies in multidisciplinary workflow coordination. Lafferty et al. (2020) identified that the most impactful causes of chemotherapy delay are workflow-level issues, including unsigned physician orders, uncommunicated

care plan changes, and laboratory coordination failures, rather than clinical complexity alone. Gass Track directly addressed these bottlenecks by pre-verifying patients during outpatient visits and initiating pharmacy preparation before admission. This approach mirrors evidence from Blackmer et al. (2021), who showed that pre-preparation of oncology medications significantly reduces turnaround times, and Jen et al. (2023), who achieved a 46% reduction in chemotherapy wait time through scheduling and pharmacy optimization in a Singapore cancer centre.

From a health systems perspective, the successful implementation of Gass Track within Indonesia's BPJS Kesehatan framework demonstrates that workflow innovation is achievable under national insurance constraints. Schaefers et al. (2022) identified limited bed availability and administrative processing as key bottlenecks in BPJS-covered oncology care, consistent with pre-intervention conditions at Dr. Kariadi Hospital. The program's ability to reduce length-of-stay without additional costs aligns with the cost-containment imperatives of the JKN system (Yuliastuti et al., 2023), and is conceptually supported by the decade-long cancer fast-track programme in Spain (Chirivella et al., 2021), which demonstrated sustained institutional adoption of streamlined oncology pathways within a public insurance model.

Monthly throughput increased by 9.4% (from 441.2 to 482.5 patients/month) without additional resources, consistent with evidence that structured clinical pathways improve both efficiency and protocol adherence (Hertler et al., 2020). The selective application of Gass Track to approximately 8% of patients reflects appropriate clinical gatekeeping: patients requiring intensive monitoring or complex protocols were managed through conventional pathways, in line with international safety recommendations (Jen et al., 2023). While no acute operational strain was observed over the 12 months, nurse workload and occupational stress were not formally measured and should be addressed in future studies using validated instruments and time-and-motion analysis.

4.1 Limitations

This study has several limitations. First, the pre-post observational design without a parallel control group limits the ability to establish causal inference. Although the reduction in chemotherapy delay was temporally associated with implementation of the Gass Track program, other unmeasured systemic factors may have contributed. Second, the study was conducted in a single tertiary public hospital, which may limit generalizability to other healthcare settings with different administrative or financing structures. Third, although individual patient-level delay data were used for statistical analysis, the study period is relatively short and does not capture longer-term sustainability. Finally, staff workload and burnout were not formally measured, despite potential redistribution of tasks.

4.2 Future Research

Future studies incorporating cost-effectiveness analysis, patient satisfaction outcomes, staff wellbeing assessments, and multi-center designs would provide additional evidence to support broader implementation of the Gass Track program across Indonesian hospital settings.

5. CONCLUSION

The Gass Track chemotherapy program effectively improved service efficiency and timeliness at Dr. Kariadi Hospital, reducing the median chemotherapy delay from 7 days (IQR: 6 8) to 4 days (IQR: 3 5), a statistically significant improvement (Mann-Whitney U = 12,988,890; $p < 0.001$; rank-biserial r = 0.877, large effect). A total of 509 patients (8.1% of eligible cases during June 2023 to June 2024) received care through the redesigned pathway, and monthly throughput increased by 9.4% without additional financial resources. The innovation is feasible, sustainable, and beneficial for oncology service quality improvement within the operational and administrative constraints of Indonesia's national health insurance framework.

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