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Interdependence of Laboratory Turnaround Time, Nursing Workflow, and Patient Satisfaction in Healthcare Delivery

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Abstract:

Background: Laboratory turnaround time (TAT), defined as the time between collection of the sample and making the results available for the clinician, is a key indicator in healthcare. TATs can affect nursing workflows and patient satisfaction. Delayed TAT can increase nurse workload, disrupt care delivery, and decrease patient trust, while short turnaround time promotes efficiency, satisfaction, and patient outcomes. **Aim:** To assess the impact of TAT on nursing care delivery and patient satisfaction, identify potential steps for optimizing TAT, and address the barriers to changing TAT. **Methods:** This review comprised a synthesis of peer-reviewed literature examining the effect of TAT on nursing workflow, patient satisfaction, and interventions, including point-of-care testing (POCT) and electronic health record (EHR) integration, based on clinical, operational, and patient-focused outcomes. **Results:** Long laboratory turnaround time can worsen nurse workload, increase stress, and raise error rates, with the worst impact occurring in high acuity settings. Similarly, shorter TAT had an improved workflow by allowing for POCT to remove redundant activities. Long TAT can negatively lower patient satisfaction due to the added anxiety of waiting, while the less time a patient waits, the better. Optimizing TAT improves care delivery and trust with patients. Interventions such as POCT and EHR integration can reduce TAT by about 20-50%. Barriers to optimized TAT can include costs associated with creating an intervention and staffing shortages. Professional collaboration and creating standardized TAT protocols may help to eliminate delays. **Conclusion:** Improving TAT can improve healthcare efficiency and improve patient satisfaction. Implementation of POCT, electronic health record interface, and standardized protocols will be crucial, and support with education and investigation on cost-effective solutions.

Keywords: Laboratory Turnaround Time, Nursing Workflows, Patient Satisfaction, Point-of-Care Testing, Electronic Health Records.

Introduction

Laboratory turnaround time (TAT), which is defined as the duration of time from the collection of a clinical sample to its results being available to the healthcare providers, is one of the foremost metrics to evaluate the efficiency of healthcare delivery (Apostu et al., 2021). In nursing, where access to timely laboratory results is essential to make treatment decisions and modify care plans as well as monitor patients for deterioration (especially in the context of EDs and Intensive Care Units), prompt laboratory results are crucial for starting treatment, moving patients, or integrating further care. Nurses rely on accurate and timely laboratory information to allow for coordination of patient care and respond quickly to changes in patients' conditions. TAT is a vital metric for the delivery of clinical operations, as it is related to the delivery of services and therefore may influence the degree to which patients' perceptions of quality of care and positive experiences in the healthcare system, representing an important area of focus for healthcare improvement processes.

TAT delays can impact nursing workflows and patient outcomes. Delays in laboratory results result in increased nurse workload because when laboratory results are not provided promptly, nurses will have to do additional patient assessments or contact laboratory staff multiple times to retrieve important information (Ballin et al., 2022). Care can be disrupted by delays in providing care, such as delays in offering interventions or making medication errors that affect patient safety and quality of care. In both the emergency department (ED) and the intensive care unit (ICU), time is critical, and delays increase nurse stress and can contribute to burnout, both of which affect healthcare resources (Harrison et al.,

2018). These operational challenges need to be addressed and improved by implementing workflows to decrease TAT in nursing practices to improve workflows and patient care.

TAT not only affects clinical workflow but also affects patient satisfaction. Since TAT and the provision of results are directly associated with perceived care quality, TAT will have a substantial impact on patient expectations. Delayed laboratory results via TAT will likely lead to a lengthened stay for the patient, resulting in unnecessary frustration, anxiety, and a breakdown of trust in the continuity of care (White et al., 2021). Delays in outpatient settings will ultimately result in patients spending longer periods of time in clinics, negatively impacting their overall patient experience, while a more serious case in critical care settings, if a laboratory test result is delayed in reporting for urgent cases, will heighten patient anxiety about their health. This comprehensive review assesses the numerous ways in which the TAT influences the delivery of care by nurses and the patient experience, with an emphasis on identifying barriers, evaluating successful interventions, and suggesting future directions for healthcare delivery.

This review aims to investigate the important relationship between TAT in the laboratory, nursing practice, and patient-centered care. First, the review will assess the effect of TAT on the registration of nursing workflows and the delivery of care, considering the effect on task prioritization, care coordination, and operational efficiencies in a variety of healthcare environments. Second, the review will investigate the relationships between TAT and patient satisfaction depending on whether results are timely or delayed, and qualitative and quantitative evidence will be used to analyze how any perceived quality of the

care is shaped by TAT. Last, the review will highlight methods to optimize TAT, including POCT testing, EHR integration, and standardizing protocols, while considering the obstacles to implementation and providing insights on actionable recommendations to improve outcomes for nurses and patients.

Methods

This integrative review was conducted using a systematic process, including a search of the databases PubMed, CINAHL, and Scopus for peer-reviewed articles published between 2015 and 2023. The search used keywords such as "laboratory turnaround time," "nursing care," "patient satisfaction," and "clinical outcomes." The studies included were in English, focused on nursing within the context of laboratory TAT, and included patient outcomes in either the inpatient or outpatient setting.

Impact on Nursing Care Delivery

Laboratory TAT has a significant impact on nursing care delivery, especially in high-acuity clinical environments like emergency departments (EDs) and intensive care units (ICUs). In these settings, timely laboratory results are critical to enable prompt clinical decision-making. For example, Brown et al. (2019) illustrated how delays for arterial blood gas results in ICUs can restrict necessary ventilator adjustments and result in increased stress and workload for nurses conducting time-consuming patient assessments to still provide care in light of incomplete data. Fernandes et al. (2022) characterized the long TAT typical to the laboratory process in the ED setting as resulting in delays for interventions, especially for troponin levels in patients suspected of having acute coronary syndrome, upon evaluation of potentially very time-critical care. Compounding the work, the absence of complete diagnostic results places an increased burden on nurses to deliver care in less-than-

ideal circumstances. This can lead to inefficiencies, as in many cases, nurses are the liaison between laboratory and clinical teams who need sample collections and to communicate laboratory results (Thakur et al., 2023). Increased length of TAT compounds these duties, which results in duplication of tasks, and in some cases, monitoring/reporting lab test results, which can lead to errors (Morias et al., 2018).

Increased TAT varies greatly across departments, but can be dramatically reduced when TAT is short, like during POCT in a critical care setting. In a recent study, Carson (2022) studied the perceived amount of time lab sample collection took and reported an overall decrease in the length of TAT by approximately 40% for Electrolytes and Glucose, which ultimately allowed nurses to engage in patient monitoring, not clerical or follow-up duties. Length of TAT can also vary based on patient acuity, but, for length of TAT area across all tests and settings that can negatively impact nurse morale, Brenner et al. (2016) recently concluded that consistent short delays primarily contributed to nurse burnout because in their review a lack of lab results places undue pressure on the nurse to help relieve the patient's stress because of time, have enough time and enough staff to conduct the appropriate care for patients whose hospitals may be overworked and under-resourced (Gohar & Nowrouzi-Kia et al., 2022). Figure 1 summarizes the workflow of TAT.

Figure 1. The workflow of TAT.

Impact on Patient Satisfaction

From the laboratory aspect of patient care, laboratory TAT is in the top ten timely analyses for patient satisfaction, in that performance better at shorter TAT improves selected patients' perceptions of the speed and quality of care. Long TAT typically results in prolonged patient wait times and can precipitate patient frustration, anxiety, and decreased confidence in the healthcare provider (Wilson et al., 2023). In outpatient clinics, delayed chemistry panel results can result in lengthy visit duration, ultimately negatively impacting the patient experience (Colvin et al., 2023). A study by Alelign & Belay (2019) found that patients waiting for a delayed clinical consultation reported significantly lower patient satisfaction scores attributed to the wait times, which represented a significant driver of dissatisfaction. In contrast, that same research found that TAT was more rapid, such as POCT for glucose and cardiac biomarkers, which can improve patient perception of care delivery efficiency. Similarly, Marcus et al. (2021) identified that patient

satisfaction improved by 20% due to the availability of immediate glucose results at diabetic clinics because patients felt that their health conditions were more adequately addressed.

Overall, qualitative studies highlight the important role played by nurses in offsetting patient dissatisfaction that arises from TAT delays. In fact, patients prefer to be informed of the estimated timelines for expected results, and this is often accomplished by nurses (Hill et al., 2023). In critical care settings, for example, prolonged TAT may cause higher levels of anxiety in patients, particularly when waiting for results about life-threatening conditions (Paul et al., 2023). A recent study by Byrum (2021) indicated that decreasing TAT for CBC result reporting in EDs by 30 minutes improved patient satisfaction scores by 15% showing a direct relationship between TAT and patient experience. Figure 2 provides an overview of the relationship between TAT and patient satisfaction
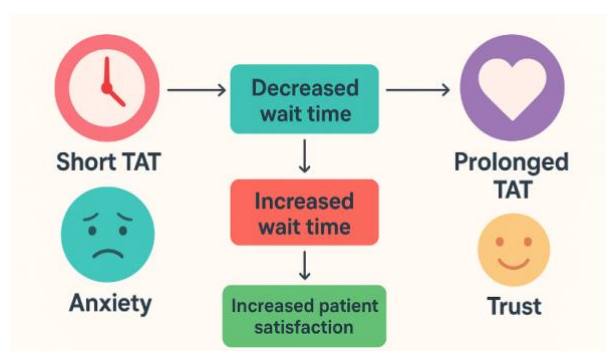

Figure 2. Relationship between TAT and patient satisfaction.

Interventions to Improve TAT

To address the challenges related to TAT and improve nursing time efficiency and patient outcomes, several interventions are currently being implemented. One of the most promising interventions is point-of-care testing (POCT) for both laboratory and non-

laboratory tests. Employing POCT promptly for time-sensitive tests such as electrolytes, cardiac biomarkers, and blood gases is a very effective strategy. Kundu et al. (2021) reported that POCT in EDs resulted in a TAT that was up to 50% shorter and gave nurses a prompt result to use for quicker clinical decision making. Nurses trained in POCT also reported as much as 50% improvement in their workflow, in terms of time spent following up on laboratory results (Bøtker et al., 2018). POCT implementation will also require initial training and ongoing quality control practices to provide an accurate report of the POCT results (Ørvim Sølvik et al., 2018).

Technological innovations also provided interventions shown to be of value, including electronic health records (EHRs) with laboratory information systems. Fan & Wang (2021) showed that EHRs reduced TAT by 20%, in that they provided timely reporting of results and allowed automated alerts for critical values. By employing this strategy, nursing staff will respond appropriately and faster as a result of key alerts made from EHRs (Umar et al., 2019). Interprofessional collaboration is another core intervention, and not surprisingly, Green et al. (2022) found that the best way to improve collaboration, and ultimately reduce TAT variability, was to hold regular meetings across the interdisciplinary function. However, even with regular meetings, implementation of the priority schemes will only reduce TAT, for example, recognizing that "stat" orders are more urgent than normal orders in making sure urgent orders are completed before normal orders typically lowers TAT by 15% in order of priority in the order processing scheme in busy or high-volume environments (Smith, 2020). Lean management techniques, such as process mapping, designing workflows, and improving workflows or simplification of workflow, have reduced the laboratory TAT by up to 25% or more if efficiencies

are done wisely (Wilson et al., 2023). Cost, resource shortages, and resistance to change by the staff are real limitations to laboratory TAT interventions and are useful in situations where the resource environment cannot support continued laboratory TAT optimizations (Hennein et al., 2022). Figure 3 summarizes the strategies to optimize TAT.
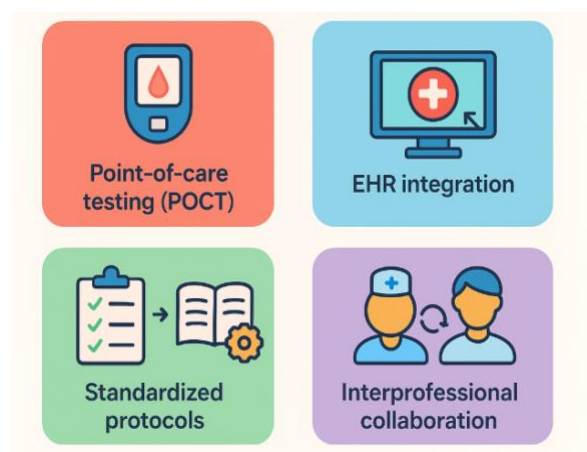

Figure 3. Interventions to optimize TAT.

Challenges & Barriers

Laboratory TAT is affected by various distinct barriers; the main barriers are related to operational limitations, resource limits, and systemic inefficiencies. High laboratory workloads, clinical staff shortages, and issues are known systems or systemic factors that otherwise impact laboratory workload (Gohar & Nowrouzi-Kia et al., 2022) are all known causes of delays in TAT when hospitals are under-resourced or challenged with staffing shortages related to clinical supply chain and not the laboratory itself that can add delays in laboratory processes and operations. Communication between the clinical staff (nurses) and laboratory staff tends to be clearly inconsistent and not totally transparent, and unfocused often impacts reports due to unclear priorities or lags in time. With outdated or under-resourced laboratory facilities, and where laboratory processes rely on non-electronic manual processes, TAT will increase even

more so with sites, and will be evident, especially in low-resource sites may not be able to provide higher clinically ordered tests (Thakur et al., 2023).

Factors related to patient factors (e.g., failure of the nurse to collect a sample from the patient properly) can also affect turnaround time (TAT). Ombelet et al. (2022) indicated that inadequate education on proper sample handling and prioritization often results in rejected samples that need to be recollected for processing, delaying TAT. Financial factors prevent more advanced technologies that would focus on TAT, for example, Goel et al. (2023) identified that the high cost of point-of-care testing (POCT) devices and POCT maintenance created barriers to implementation in low-resourced settings. Furthermore, staff resistance to change, specifically when facilities implement new protocols or new technologies, can hinder TAT optimization efforts (Hennein et al., 2022).

Summary of Key Findings

Table 1 summarizes the reviews' key findings with regard to TAT and the implications on nursing care delivery, patient satisfaction, interventions, and considerations.

Aspect	Key Findings	References
Impact on Nursing Care	Delays increase workload, stress, and errors; rapid TAT (e.g., POCT) improves efficiency.	Fernandes et al., 2022; Brown et al., 2019; Carson, 2022
Impact on Patient Satisfaction	Prolonged TAT reduces satisfaction; rapid TAT and clear communication improve experience.	Wilson et al., 2023; Byrum, 2021; Marcus et al., 2021
Interventions	POCT, EHR integration, standardized protocols, and lean management reduce TAT.	Kundu et al., 2021; Fan & Wang, 2021
Challenges	Staffing shortages, outdated equipment, improper sample collection, and costs hinder optimization.	Gohar & Nowrouzi-Kia et al., 2022; Alelign & Belay, 2019; Goel et al., 2023

Discussion

The literature reviewed consistently identified TAT as an important factor affecting nursing care and patient satisfaction in all types of healthcare settings. With TAT, much quicker TAT improves the quality of nursing care by allowing for more efficient nursing care. For example, when reducing TAT means that nurses avoid redundant tasks like contacting the laboratory staff to see why lab results are delayed or having to reassess the patient due to delayed reporting of a laboratory result, it frees up time for nurses to spend more time in direct patient care (Smith, 2020). In high-acuity settings, such as

emergency departments (EDs) and intensive care units (ICUs), timely results for tests, such as troponin and blood gases, allow rapid clinical decisions that help avoid harmful patient outcomes (Green et al., 2022). Conversely, a long TAT interrupts and eventually limits the effectiveness of the nurse, as they have time available but no data to act upon, and must shift their time away from patient care to simple, basic data, creating stress and worker frustration and errors (Lo et al., 2022). This is especially apparent in under-resourced settings where TAT in an already sub-optimal working environment adds significant burden to already difficult situations, including inadequate staffing, overcrowded conditions, and increasing nurse burnout and morale (Anderson et al., 2017).

Strategies to reduce TAT and improve care delivery include point-of-care testing (POCT) and integration with electronic health records (EHRs). For example, the nurse can now secure results for life-ending tests like electrolytes or cardiac biomarkers in a matter of minutes, hence improving workflows and outcomes (Kundu et al., 2021). However, the investments for equipment costs, staff education, and maintenance are often too great in low-resource settings to invest in (Green et al., 2022). EHR integration allows real-time transmission of results and alerts for critical values, thus allowing nurses to respond quickly and decreasing TAT according to some studies by up to 20% (Fan & Wang, 2021). However, the usage of EHR and LIMS systems was limited because of inconsistent adoption, employee hesitancy towards new technology, and financial impact (Hennein et al., 2022).

Nurses play an important role in decreasing TAT-related issues in the laboratory. Unlike physicians, nurses serve as go-betweens for laboratory and clinical teams. Minimizing delays for TAT that occur due to improper sample collection (a nurse not asking for a fasting sample), or miscommunication of results between the nurse and physician is dependent on effective communication and proper sample handling by nurses (Anderson et al., 2017). Interprofessional collaboration with nursing is equally important, as studies suggest nurses and laboratory staff should be trained together to align priorities and coordinate care (Wilson et al., 2022). Collaboration offers an opportunity to decrease TAT variations and help improve efficiency, particularly in high-volume areas where adherence to protocols is not always possible.

From the perspective of the patient, TAT contributes broadly to satisfaction, as same-day lab results contribute to their perceptions of timely care and high-quality care (Ridho et al., 2021). Wait times of hours for results, particularly in outpatient or emergency rooms, do contribute to feelings of frustration and anxiety as well as limiting trust in care providers (Alelign & Belay, 2019). Nurse-led conversations on expected result update timelines have been demonstrated to lessen these negative experiences, as patients value honesty and communication during their care (Hill et al., 2023). Byrum (2021) found that reducing turnaround time (TAT) for reportable results of complete blood count (CBC) by 30 minutes in the emergency departments (EDs) increased patient satisfaction scores by 15%, indicating TAT plays a role in shaping patient experience.

Future research should focus on cost-effective methods to reduce turnaround time, specifically in situations where the technology, such as point of care testing (POCT) may not be achievable in low-fidelity settings (Khatab & Yousef, 2021). Longitudinal studies are also warranted to assess the impact of interventions such as POCT and electronic health records (EHR) on nurses' workflow and patient

care over time (Schumacher et al., 2020). Additionally, qualitative studies examining the patient experience regarding TAT would add valuable data to designing strategies to support patient-centered care that recognize patient communication needs and concerns about wait times (da Cruz & da Silva Martins, 2019). Addressing these gaps in the literature will better align TAT interventions with the needs of nurses as well as patients related to TAT.

Recommendations

To optimize laboratory turnaround time (TAT) and to improve nursing care delivery as well as patient satisfaction, a multi-faceted approach embracing practice, education, policy, and research is recommended. Healthcare settings must incorporate point-of-care testing (POCT) into high acuity care, such as the emergency department (ED) and intensive care unit (ICU), when it is desirable to have rapid results for critical tests. A nurse can receive training on how to label a specimen and handle it properly so that they do not delay care (Malla & Amin, 2023). Integrating electronic health record (EHR) systems into laboratory systems regarding communication can also be an important strategic process for decreasing the time for results. The reduction can be up to 20% (Fan & Wang, 2021).

From an educational perspective, interprofessional training would help collaborative learning between nurses and laboratory staff to reduce turnaround time for results by improving communication regarding standardized processes (Gamble et al., 2023). From a policy perspective, developing standardized turnaround time protocols for urgent or critical tests and seeking funding for point-of-care testing technology are especially important in resource-constrained settings (Garcia et al., 2018). Systematic efforts to describe the cost effectiveness

for POCT technology interventions, and ongoing studies to determine the long-term sustainability and effectiveness (>6 months) of technology in low resource environments, is also imperative if you are to develop evidence-based care practices that improve the improvement of care delivery and patient outcomes (Vázquez et al., 2021).

Conclusion

Laboratory turnaround time has a profound impact on nursing care delivery, as well as patient satisfaction. Timely laboratory information has the potential to improve nursing care efficiency by decreasing unnecessary future nursing tasks, decreasing workload, and optimizing clinical decisions in a timely manner, all of which can improve patient outcomes. Conversely, increased TAT creates workflow inefficiencies that cause stress for nurses and make patients less likely to trust those who are caring for them, resulting in lower quality of care and lower satisfaction. Innovations like POCT, EHR integration, and standardized protocols can meaningfully reduce TAT, and possible future applications may all be affected by barriers such as staffing shortages, outdated technology, and a lack of funds. If health systems support interprofessional development, educate, and equip providers, they will be able to overcome barriers and engage in solutions that address TAT reduction for both nurses and patients. Future research should include exploring cost-effective solutions and including the patient's perspective to identify opportunities to strengthen care delivery, assuring laboratory TAT is meeting the creation of timely, high-quality, and patient-centered care.

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