The Triad of Care: Synergizing Nursing, Pharmacy, and Laboratory Medicine for Optimal Patient Outcomes

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1. INTRODUCTION

Recent innovations within the healthcare field have made the way medicine is practiced unrecognizable compared to just 10 years ago, affected by inter alia, the needs of the patient, the complex and challenging details of chronic illness and the burgeoning body of medical knowledge. Single person practices wherein the doctor would examine and decipher the illness of a patient alone are now a relic of the past. The healthcare ecosystem and new approach to providing healthcare services is based on the fact that individual health is not attained and cannot be the result of a single health care worker, rather a constellation of several specialists and a coordinated effort and synergy within a healthcare team is necessary. The traditional methods of providing healthcare to patients that operate within boundaries of a single discipline (i.e. 'silos') have proven to be inadequate to meet the complex patient needs of today. Given this and the growing body of literature on interprofessional collaboration (IPC), healthcare systems globally are

starting to incorporate collaborative care where healthcare professionals from different disciplines join forces to offer integrated care focused on the needs of the patients.

Historical development of medical care has created a complex network of health care professionals working together to provide care to patients. The Nurse, Pharmacist, and Laboratory Medicine Practioners are among the most important health care professionals, and yet are some of the most underappreciated. While Nurses, Pharmacists, and Laboratory Medicine Specialists are not medical doctors, and thus lack the final diagnostic and decision making powers, they are critical to the provision of safe, supportive, and responsive to patient needs care. Nurses act as the primary point of contact and stabilizing force in the bedside team, monitoring the care and response of the patient while arranging and organizing the diverse team of health care providers. Pharmacists ensure that while the patient heals from a disease using the medications that are clinically strong, complex, and carefully contructed. Laboratory Medicine provides the accurate, unbiased, essential data that controls the majority of medically based decisions, controlling the discovery and monitoring of disease and organ funciton. Their work, which is often not shown to the medical teams, is essential to the ecosystem of modern medicine.

Incorporating these three fields is not just an administrative matter, but rather a clinical and ethical necessity. Interprofessional cooperation has been acknowledged by the World Health Organization as fundamental to developing health systems and is defined as the activity during which professionals encounter one another to enhance health outcomes. Absence of a given profession in the HealthCare Team structures is a void in synergistic cooperation. The patients are the ones to be affected by such isolation. A result from the laboratory that is delayed is a diagnosis that is missed; an error in the prescribed medicine that is not reviewed is a life that is placed at risk; an unrecorded symptom by a nurse is a lost piece of a clinical puzzle. On the contrary, the dismantling of such “walls\" particularly among the hospital ward, pharmacy and laboratory is associated with great benefits. For instance, there is proof that this collaboration has resulted increased patient safety by a decrease in medication errors, improvement in medication adherence, and decrease in chronic hospitalizations.

2. THE DISTINCT YET INTERCONNECTED ROLES

The strength of a healthcare institution is not determined by the achievements of one individual but by the combined achievements of a unit of the multidisciplinary workforce. To appreciate the contributions of the triad of nursing, pharmacy, and laboratory medicine, one needs to understand the contribution of each discipline individually. While their daily functions span the entire continuum of care from bedside to bench—they all aim to save a life. This chapter attempts to explain the contributions of each of the three professions by illustrating how the individual competences each serve as a beacon for the combined constellation of care.

2.1. Nursing: The Constancy and the Voice of the Patient

In the well-oiled machine of a hospital, the nurse is the lone and sole human interface for the patient and the entire system. They perform hands-on patient care, assess the effectiveness of interventions, manage the care plan, and offer education to patients and their families. Unlike other practitioners who may see a patient once every hour or two, nurses are present all the time and and act as the medical team's 'eyes and ears'. This vantage point enables them to identify changes in the patient's condition—such as new confusion, color changes in the skin, or a blood pressure drop.

Nurses' roles go beyond just following the orders that doctors give. Their duties are part and parcel of the biopsychosocial approach. Nurses combine biological surveillance and the psychosocial aspect that addresses the emotional toll of the illness. They are the ones who decode sophisticated medicine and communicate it in the simplest and most understanding ways to the distressed patients. Moreover, nurses are the most important links in the exchange of information between members of the healthcare team. It is the nurse who gets the call first and is the one to act when a critical laboratory result is received. It is also the nurse who sees the adverse symptoms of a drug first and calls the attention of the pharmacist and the doctor.

As a result, the nurse has to defend the patient the most. They are the ones who do the comprehensive inspection of the patient and make sure that the plan of care addresses the clinical requirements and is also in line with what the patient wants and needs. In the triad, the nurse is the primary information gatherer and the one who executes the plan of care last and is also the one who bears the burden of the therapies created by other people.

2.2. Pharmacy: Protecting Patients from Drug Misuse

While nurses stand vigil at the bedside, the pharmacist stands as a sentinel of the healing armamentarium. The pharmacist's role encompasses the integration of the pharmacotherapy expertise, the management of the medication therapy, the prevention of medication interactions, and the refinement of the therapeutic regimen5. The contemporary pharmacist practices beyond the mere act of dispensing medication. They are the clinical artisans who work to ensure that the largely unregulated pharmacological agents that interact with the biochemistry of the human organism do so with the intent to mitigate and resolve the present pathophysiological state.

As a result of the chronic disease burden on health care systems, and the growing presence of polypharmacy within patient populations, the likelihood of adverse drug events occurring is significant. The pharmacist is trained in pharmacokinetics and pharmacodynamics to a much greater degree than the average health care professional6. They work to define and resolve medication therapy problems, work to resolve therapeutic pluridisciplinarity, and design and implement rational clinical pharmaceutical care plans7. To exemplify, a pharmacist in charge of the care of a patient with chronic kidney disease does not stop at processing a medication order. They are expected to critically interpret the patient's laboratory renal function values, and based on this,

determine the drug dosage required to maintain a therapeutic concentration and avoid toxicity.

As the last gatekeepers of medication therapy management (MTM), pharmacists contribute substantially to patient safety via mitigation of prescription errors and enhancement of compliance. Prior to the dispensing of any medication, pharmacists serve as a safety net by screening prescriptions for potential allergies, duplication of therapy, and drug regimen incompatibilities. Their involvement in the prescription monitoring process is associated with fewer hospital readmissions and shorter hospital stays as they ensure the prescriptions are tailored to the unique needs of the patient. Within the triad, the pharmacist depends on the nurse to carry out the implementation of these precision medication therapy orders, and on the lab for pertinent information to guide the decisions.

2.3. Laboratory Medicine: The Hidden Detectives of Diagnosis

Although nurses and pharmacists have a direct role in patient care, laboratory medicine specialists work out of sight and have a huge impact on care provided to patients. Clinical laboratory services are fundamental to today's health care systems, as they provide the essential data needed for every clinical decision. Although laboratory tests are a small part of the health care expenses, they impact more than 70% of clinical decisions.

In the medical world, clinical laboratories are the "detectives". They investigate biological specimens (e.g. blood, urine, tissues, and other bodily fluids) for abnormalities, pathogens and the status of a disease. In the subfields of the clinical laboratory, such as clinical chemistry, hematology and microbiology they provide the necessary evidence confirming or disproving a diagnosis13. For instance, without laboratory evaluation of troponin in a patient that presents with chest pain, the medical team cannot determine whether the cause is trivial (e.g. indigestion) or is a dire case of myocardial infarction.

The laboratory also plays a role in the treatment. It assesses the effectiveness of the treatment and provides data that helps the clinician to select appropriate therapies for the patient. For example, in treating a patient with hyperglycemia, the laboratory is essential in monitoring blood glucose level.

3. THE NURSE-LABORATORY INTERFACE: PRECISION BEGINS AT THE BEDSIDE

The interaction between nursing and laboratory medicine is one of the most important working relationships in a hospital. Even though the nurses are physically located on the upper floors and the laboratory is in the basement, their workflows are connected. Each nurse is the laboratory's supply line (raw materials in the form of specimens) and the nurse is the laboratory's customer (the nurse is not able to treat the patient without the laboratory's vital intelligence in the form of results). This is where the "precision" of modern medicine and the "reality" of patient care intersect. It is a relationship characterized by partnership, sometimes communication, and sometimes friction. When working in harmony, the interface provides the rapid and accurate diagnosis the patient

needs. When it breaks down, though, the interface is the source of patient suffering and potential misdiagnosis and is a cause of prolonged patient suffering and discomfort.

3.1. The Pre-Analytical Phase: The Human Factor in Sample Collection

A diagnostic test begins not with the sample, but with the patient, and in most cases with the nurse. This is the pre-analytical phase, the most OH vulnerable part of the test process, and the part with the highest potential for error as it is estimated to account for over 70% of laboratory testing errors. It is the phase most dominated by the human variable.

Draw the sample. To the patient, it is a moment of pain and suffering. To the nurse, it is a technicality, one of over a dozen things to do. However, the quality of this act determines the reliability of the data. If a nurse leaves a tourniquet on for too long while trying to find a vein, the blood may hemolyze, leading to the release of potassium into the serum. The laboratory will then record false potassium elevated levels. This is pseudohyperkalemia. There's no such thing as a lab error. It's a pre-analytical artifact.

The error in this situation is profoundly human. The lab has no choice but to reject the sample, and, in consequence, the patient has to undergo a second draw. In this scenario, the patient is explained to a nurse that they will have to get stabbed a second time, and this is especially concerning when the patient is elderly or in pain. This is the patient's trust that will cause needless suffering. In the meantime, the patient's treatment is on hold, awaiting the lab's valid answer. So, it is no wonder why the order of a tube, the mixing of additives, and the accurate patient labelling, is not just form-filling bureaucracy, but compassion, and, ultimately, patient safety.

3.2. Communication of Critical Values: When Seconds Matter

No aspect of nursing and laboratory medicine shows more of a crossover than reporting critical (or “panic”) values. Critical values are lab results so abnormal or extreme that they indicate an immediate, life-threatening condition. For example, an individual with a hemoglobin of 5.0 g/dL is suffering from a severe hemorrhage, or a patient with a glucose of 40 mg/dL is hypoglycemic and at risk of severe complications.

It is at this point that a laboratory becomes more than a data mill and an information processing center; it becomes a center that protects life. A laboratory professional, noting a red flag, stops processing and verifies the result. After confirming the result, laboratory staff must pick up the telephone immediately. On the other end of the line is a nurse: the lifesaving lifeline. The life and death stakes of this transactional process, and the critical handoff that accompanies it, cannot be overstated.

In these situations, there must be effective communication, using what is known as the “read back” method as required by The Joint Commission and various safety organizations. The lab scientist gives the value and the patient’s name, and the nurse documents it and reads it back to affirm that it is correct. This is done to avoid situations where “15” could be misinterpreted as “50”. However, there is a human element at play, too. In a busy ER, a nurse depends on the lab to communicate the urgency, and on the

other hand, the lab expects the nurse to act immediately by hanging up the phone, getting the crash cart, or giving a dose of glucose. This sequence of activities, often taken for granted, is what we refer to as the Triad of Care in its most advanced form.

3.3. Point of Care Testing (POCT): The Lab Has Moved to the Nurse

In the past, a laboratory was a large and secure space where samples taken by the clinician were shipped out for analysis. With the advent of technology, this centralized model is being transformed by Point of Care Testing (POCT), which puts the laboratory in the hands of the clinician, or nurse. Nurses are being trained to do diagnostic tests at the bedside using devices like glucometers and blood gas analyzers (i-STAT).

This shift allows nurses to make instantaneous decisions. During a diabetic emergency, a nurse would not wait one hour for a central lab to return a glucose level. They acquire a glucose level in ten seconds and treat the patient. However, conveniences come with added burdens. The nurse acts as a "remote lab tech"; QC, and device custody, and QC are their only responsibilities.

When a nurse does not complete the daily QC on a glucometer, the glucometer may register a wrong low, and therefore, insulin may unjustifiably be withheld from a patient who needs it. Hence, the relationship between the central lab, which oversees the POCT program, and nursing leadership is essential. The lab has control and oversight, and therefore, convenience at the bedside does not sacrifice control. This relationship recognizes the nurse as the provider of direct care and that the testing process is, despite what the nurse may think, a communal act of true science.

Reducing Errors through Mutual Understanding

The "silo mentality" is often the source of friction between nursing and the laboratory. Nurses may see the lab as "picky" or "obstructionist" when a clotted sample is rejected. Some laboratory professionals may view nurses as "careless" when there is a sample with a misspelled label. This dynamic is adverse.

To close this gap, some progressive healthcare organizations are promoting interprofessional empathy. Nurses are less frustrated and more inclined to prevent the rejection when they know that a clotted sample cannot be analyzed because the clot is likely to block the probes of the analyzer, and it skews the cell counts. On the other hand, when laboratory professionals know that there is a cardiac arrest and it is not possible to get a perfect, hemolysis-free sample, they may reconsider other options to be able to prioritize the limited sample volume for the most important tests.

4. THE PHARMACIST-LABORATORY AXIS: DATA-DRIVEN THERAPEUTICS

If the collection interface between the nurse and the laboratory is the 'first line' of data collection, then the partnership between Pharmacy and Laboratory Medicine is the 'intellectual engine' of optimizing therapies. In today's healthcare system, the era of 'one

size fits all' is history. Today, safe pharmacotherapy is a graduated process that is dependent on laboratory derived physiological data. The pharmacist, as the principal custodian of medication safety, will be unable to fulfill this responsibility without the continuous tide of laboratory data. This is the axis on which the disciplines of chemistry and biology pivot. This is the axis on which the immeasurable potential of a medication is harmonized with the emerging reality of a given patient.

4.1. Therapeutic Drug Monitoring (TDM): The Tightrope between Clinical Benefit and Adverse Drug Reactions

One of the most evident synergies between these disciplines is Therapeutic Drug Monitoring (TDM). Some classes of medications are very powerful and carry a high degree of risk. For example, antibiotics (Vancomycin, Aminoglycosides), immunosuppressants (Tacrolimus), and mood stabilizers (Lithium) are examples of medications that possess what is termed a 'narrow therapeutic index'. This means that there is a very small, narrow margin of safety between a therapeutic and a toxic (deadly) dose.

Vancomycin provides a chance for survival for someone with a serious MRSA infection. However, if not enough is given, treatment failures result, and patients can develop sepsis. However, if too much is given, patients suffer irreparable damage to their kidneys and can lose their hearing. The physician orders the first dose, but it is the Laboratory that measures the specific concentration of the drug that is in the patient's system (the "trough" level) a few hours after the dose is given. The number, by itself, is meaningless, and needs to be put in a context.

This is the time when the Pharmacist is involved. The pharmacist takes the lab result and, using the patient's demographics (weight, age, and renal function) to apply pharmacokinetic calculations, to adjust it and estimate the dose using the appropriate. This is a personal safety measure, and it takes much more than just mathematics. Without accurate and timely lab measurements, the pharmacist is interpreting data with no context. Without context, the lab data is just a number on a screen. Together, they keep the patient in the "Goldilocks zone" of therapy – safe and effectively treated.

4.2. Antimicrobial Stewardship: The Lab's Antibiogram and the Pharmacist's Prescription

One of the most crucial collaborations for Antimicrobial Stewardship Programs (ASP) is between the pharmacy department and the microbiology laboratory. During a patient's initial workup and while waiting for culture results in the case of severe infections, a patient is typically started on broad-spectrum antibiotics; a certain "carpet bombing" approach to which the patient is biologically tolerant. Although, in the case of bacterial superinfections, clinicians are blindsided by the "bio cost" of the approach: broad-spectrum antibiotics can lead to the outgrowth of resistant pathogens and/or negatively affect a patient's normal microbiome.

Sepsis is life-threatening disease, and families are understandably anxious to receive updates. Although culturing from blood and urine is a cornerstone of laboratory diagnostics, it is critically important to mitigate economic losses by managing the patient's antibiotics and monitoring for clinical deterioration during the time required for culture growth (approximately 24 to 72 h). During this time, the pharmacist is managing the patient's clinical data and assessing for clinical deterioration.

Once the laboratory isolates the specific microorganism(s) and generates the Sensitivity Report (Antibiogram)—chronicling the specific antibiotics that will eradicate the pathogen and the resistant ones—the interaction shifts. The pharmacist analyses the information and acts to "de-escalate" therapy. She advocates changing from the harmful broad-spectrum agent to one of the less toxic molecules that is safe not only for the individual but also for the population. This laboratory-driven therapy and pharmacy executed targeted treatment eliminates the risk of the patient (C. difficile infection) and secures the appropriate treatment of the infection.

4.3. Pharmacogenomics: The Next Stage of Individualized Medicine

The Pharmacist-Laboratory spectrum will be in the discipline of\nPharmacogenomics; that is, the field that examines the alteration of an individual's genes and their response to specific agents. This is the farthest departure from the theory and practice of 'trial and error' to a theory based practice.

Traditionally, a patient with depression would be subjected to a trial of three to four different antidepressant agents for a period of three to four months, suffering the ill effects of adverse side effects and ineffectiveness. This is risky and hazardous. Today the laboratory is able to analyze a patient's DNA through a cheek swab to detect a patient's polymorphisms in the drug-metabolizing enzymes (for example, the CYP450 family).

The Pharmacist uses the genetic information in the lab report to determine how the patient processes medications. If the report indicates the patient is a "poor metabolizer," the pharmacist will understand that the patient will reach toxic levels in the system with standard prescriptions. If a patient is an "ultra-rapid metabolizer," that person will get rid of the medication before there's a chance for the medication to take effect. Using the advanced lab information, the pharmacist will be able to recommend the correct medication, for the right dose, for every starting day. This partnership will save time and money, and document the patient's biological uniqueness, preventing the patient's physical and emotional fatigue of multiple unsuccessful treatment attempts.

4.4. Kidney and Liver Function: The Biological Filter

Any medication a person is given must be eliminated, and is usually processed through the liver and/or kidneys. The functioning of these organs is not constant and can change quickly, as in the case with critically ill patients with the potential for Acute Kidney Injury.

The Laboratory functions as the constant overseer of these biological filters, using several indicators such as Serum Creatinine, Glomerular Filtration Rate, and Liver Function Tests. These figures signal the Pharmacist to change the dose of medication.

- Green Light: If the lab values come back to be within the normal range, the pharmacist will adjust the dose to a standard dosage.

-The Red Flag: A high and sudden rise in serum is a signal that the kidneys have stopped filtering waste products.

If a pharmacist fails to catch this signal and recommends the usual dose of a drug to be cleared renally (e.g., Enoxaparin, a blood thinner), the drug can reach toxic levels and hemorrhage can occur. This is why a pharmacist has to look at every patient's lab results every day. When a pharmacist sees a patient experiencing organ failure, the pharmacist is required to determine a calculated " renal adjusted dose." This is a built-in protection against iatrogenic harm. Most patients have no knowledge that the pharmacist had to decrease the dose because the patient's results changed, but that is the intervention that kept the patient from harm.

5. **THE NURSE-PHARMACIST ALLIANCE: THE FINAL CHECK**

Although the lab supplies the navigational information and the diagnosis establishes the direction, it is the flow of therapy that depends on the partnership of both nursing and pharmacy. This union constitutes the "last checkpoint" in the healthcare continuum, the last buffer before a physician's order is transcribed to the patient's venous access. In the fast-paced, high-risk field of healthcare today, where therapy regimens are both numerous and powerful, the interdependence of the clinician who prescribes and the clinician who administers a drug is, to put it colloquially, a given. It is essential to patient safety.

5.1. Medication Administration and Safety: The "Five Rights"

At the center of medication safety is the principle of the "Five Rights": Right Patient, Right Drug, Right Dose, Right Route, and Right Time. For this to be accomplished, coordinated teamwork is required. The pharmacist brings in the knowledge of a pharmacotherapy specialist and ensures that the medication order is congruent with the patient's clinical condition even before the order is released from the pharmacy.1 They provide the first line of defense when it comes to screening allergies, drug-drug interactions, and other potential problems such as a miscalculated dose, using the patient data from the lab and the physician to guide their decision.

While the safety assessments carried out by the pharmacist possess potential, they will remain unactualized until the nurse puts theory into practice at the bedside. As the last gatekeepers, nurses are responsible for giving medication and observing the patient for any immediate reactions.33 When these two occupations work together, they form a double-layer safety net. Numerous studies show that interprofessional teams, including nurses and pharmacists, are efficient at decreasing medication errors and enhancing patient safety. For example, in facilities where there is pharmacist-nurse collaborative practice in the ICU, there is a significant decrease in the incidence of avoidable adverse drug events as pharmacists offer immediate expertise and nurses provide immediate situational context.

5.2. Medication Reconciliation: Bridging Gaps in Care Transitions

A patient is at the highest risk during a transition of care, which can involve moving from home to hospital, hospital to ICU, ICU to hospital ward, or hospital ward back home. These "handoffs" are when there is a high risk of omitting medications, duplicating them, or dosing incorrectly. Medication reconciliation as a nurse relies heavily on the Nurse-Pharmacist collaboration in order to identify and address discrepancies in medication orders.

Trained in various responsibilities and specialties, clinicians and pharmacists ensure the delivery of high-level specialized integrated care to patients, and nurses, as care coordinators, finalize integrated care as planned and educate patients about new care plans. When new medications or dosages are prescribed, clinicians and pharmacists ensure adherence to the best practice guidelines of the prescribing cascade and prescribe medications carefully and selectively to avoid and eliminate polypharmacy. In patients with complex geriatric syndromes, medications that are not indicated and medications that should be deleted are identified, and the opportunity to deprescribe is recognized. Research indicates that specialization in discharge planning, educational discharge counseling, and discharge regimen reconciliation, along with the associated pharmacist's medication regimen counseling, are effective in reducing discharge and post-discharge hospital readmissions. Ensuring that the patient does not "disappear" is a given outcome of this teamwork.5.3. Joint Management of Adverse Drug Reactions (ADRs)

Every medicine has a certain degree of risk associated with it. There needs to be a continuous dialogue between nurse and pharmacist concerning the management of Adverse Drug Reactions (ADRs). Because of their consistent presence at the patient's side, nurses are the first to notice the small signs of an adverse reaction, like a rash, a dip in blood pressure, or a change in mental state. Within the framework of the system, they are the first alert for problems.

After a reaction has been identified, the pharmacist's skills are needed to determine whether any event was in fact the result of a reaction or not. Is it a side effect of the new antibiotic, or is it a symptom reflecting the underlying disease? Completed coursework in pharmacodynamics can equip a pharmacist to answer this and then advise on alternatives. Pain management is a good case in point. In these situations, pharmacists improve the patient's regimen to better control pain at the same time avoid adverse effects like respiratory depression and constipation. Meanwhile, nurses are monitoring outcomes and factoring the pain into their prescribed intervention. Because of this design, iatrogenic harms can be avoided while the patient's condition is aggressively treated.

5.4. Patient Education: Shared Responsibility

The treatment plan would only be successful if the patient is compliant. Patients' noncompliance is a widespread problem, however, the problem is less severe when the patients' educational needs are addressed by both the pharmacists and the nurses simultaneously.

The nurses and pharmacists are a professional educational team in patient medication management. The pharmacists instruct the patients on medication usage, dosage, side effects, and considerations for medication adherence. The nurses incorporate aspects of their patients' daily routines and provide continuous self-management support. Research has demonstrated the positive correlation between medication adherence and nurse interventions alongside the pharmacists in patients suffering from chronic illnesses. The patients are less confused about their treatment and feel more empowered to manage their own condition after receiving consistent education from both their nurse and pharmacist. Educational collaboration makes the patients more than passive recipients of service; it makes them active participants in their own health improvement.

6. **THE TRIAD IN ACTION: CASE STUDIES**

Collaboration in theory builds partnerships; in reality, it is a necessity. Within the carefully worded boundaries of a policy document, the lack of collaboration purportedly espoused interprofessional collaboration as a means to "enhance the efficiency of resource use and decrease expenditures". However, to the patient on the stretcher, it is not about efficiency; it's about life or death. The clinical stories to follow demonstrate how the unparalleled collaboration of Nursing, Pharmacy, and Laboratory Medicine provides a net of protection to patients at their most vulnerable.

6.1. The Management of Sepsis: There is No Time to Lose.

Sepsis is a medical emergency. The body's response to infection is sometimes worse than the infection itself. It's a biological fire and, for each hour that antibiotics are delayed, the risk of death goes up.

The Scenario:

An elderly patient is confused and has a fever when she arrives at the Emergency Department.

- The Nurse (The First Responder): The nurse serves as the sentinel. Understanding the first signs of hypoperfusion (low blood pressure, fast heart rate), the nurse begins the Sepsis Bundle. But the nurse cannot order antibiotics until obtaining biological evidence. They must draw blood culture and lactate levels first because if antibiotics are given, the samples submitted will be heat sterilized, killing off the bacteria and hiding the pathogen.

- The Laboratory (The Detective): The sample comes to the lab and the pressure is on. A high lactate level (indicating hypoxia) is an important critical value. The lab professional confirms the value immediately and calls the nurse, completing a and signaling the start of the next phase. They are also culturing the blood. Several hours later, the machine indicating positive bacterial growth. The lab team performs a Gram stain, providing the first important clue (e.g., \Gram-negative rods), which allows the team to focus their efforts.

The Pharmacist (The Strategist). The pharmacist receives the lab (culture positive and worsened renal function alerts). The pharmacist then calculates an appropriate loading dose of a broad-spectrum antibiotic. Too low of a dose will be inefficacious but a standard dose is toxic in renal impairment. The pharmacist tailors the regimen to the labs creatinine and assesses the compatibility of the medication with the intravenous fluids the nurse is currently infusing.

The Outcome.

As it stands, it is not a sad story of a solitary doctor. The nurse drew the sample correctly, the lab did its job in an expeditious manner, and the pharmacist is the one called to give the medication. This interaction is what enables to decrease the length of stay in a hospital and prevent deaths.

- The Laboratory (The Gatekeeper) - Before therapy can commence, the laboratory must assess whether the patient can physically withstand the treatment. They run a Complete Blood Count (CBC) test to evaluate the Absolute Neutrophil Count (ANC). If the ANC falls below a certain threshold, the patient is at risk of their already weakened immune system being further compromised by the chemotherapy and ultimately dying from a fatal infection. Additionally, the laboratory checks the patient's liver and kidney function and tests as well.

- The Pharmacist (The Architect) - The pharmacist then analyzes the laboratory results. Noticing a slight elevation in the liver enzymes, the pharmacist checks the protocol and adjusts the estimate of the dosage to avoid a risk from hepatic failure. They then make the hazardous medication in a sterile environment, ensuring that the concentration is appropriate for the patient's body surface area.

- The Nurse (The Protector) \- At the bedside, the nurse cross-checks the laboratory results the last time to make sure that the results signal a "Go" for the chemotherapy. They receive the vial of medication from the pharmacy, taking time to verify that the prescription label matches the patient's armband (The 5 Rights). During the infusion, the nurse checks for any signs of extravasation (the leakage of a drug from a blood vessel) or anaphylaxis.

The Human Touch:

The patients only see a nurse hanging a fluid bag. They don’t see a lab tech analyzing the blood smear. They don’t see a pharmacist computing the drug's molar mass. However, it is these synergistic, invisible, data-driven interactions that allow the patients to receive aggressive treatments while maintaining the best possible safety margins.

6.3. Emergency Medicine: Trauma: Coordination in the Middle of the Storm

The trauma bay is the scene of a scene straight from the movies. There is a car crash, a massive outpouring of blood, and loud, chaotic, and fast commotion in the room. In this scene, the Triad acts as a logistical powerhouse with unparalleled speed.

The Situation:

Hypotensive trauma patient with a large volume of blood loss.

- The Nurse: One nurse is applying pressure while the other is gaining IV access. They then send the blood "Rainbow Draw", a collection of multiple blood collection tubes, to the lab with a 'Level 1 Trauma' status via the air tube system.

- The Laboratory: All other samples have been set aside so that the lab staff can focus on this one. They do a Type and Cross to see what blood type the patient has while concurrently running a thromboelastogram (TEG), a test that assesses why a patient is not forming blood clots, to clarify what the patient's condition is. They have been already standing by to release a unit of O-negative blood (universal donor) and are getting type-specific blood ready for delivery.

- The Pharmacist: The pharmacist has a physical presence in the trauma bay or is accessible in a matter of seconds. They make ready the epinephrine drips that boost blood pressure and tranexamic acid (TXA) that serves to clot blood. They make sure that the hundreds of transfusion blood products do not cause calcium depletion (a commonplace side effect) and direct the nurse to give calcium chloride.

The Result: In this scenario, the "silos" of healthcare need to completely fall apart. The nurse cannot be waiting for a paper report, the lab cannot be waiting for a formal requisition, the pharmacist cannot be waiting for a moment of silence to check an order. They move like a single body. There is ample evidence that such interprofessional teams in high acuity settings reduce adverse events and improve survivor rates of patients3. The life of the patient is saved in the void of the nurse's hands, the data from the lab, and the drugs from the pharmacist.

7. BARRIERS TO INTEGRATION AND HUMAN DYNAMICS

Although the integration of Nursing, Pharmacy, and Laboratory Medicine is the machine of modern healthcare, the reality of daily practice is often the brake. Interprofessional Collaboration (IPC) decreases preventable adversities and is, therefore, a requirement of modern healthcare; however, there is a gap and barriers in practice. These barriers are the result of history, psychology, the built form of our hospitals, and the human condition3. In order for us to build a truly integrated system, we need to first confront the barriers to integration.

7.1. Communication Breakdowns and Hierarchical Structures

The silo mentality is the most dominant barrier to the functioning of the Triad. It is a specific form of professional tribalism, where each discipline adheres to and emphasizes their discipline and professional identity, to the exclusion of collaborative teamwork. Healthcare, as a system, is built under a dominant hierarchy, with the physician sitting at the top and other professions as subordinates. These attitudes still exist, and research shows that power differentials in relation to the scope of authority and the hierarchy of a system are a barrier to about 53.3% of the workforce in healthcare.

These problems can undermine the safety net. A nurse may not question a medication order out of fear of being chastised. A laboratory staff might feel that their critical warning is not seen as helpful. This absence of "psychological safety" functions as a barrier to the possibility of having constructive conversations and to cooperative decision-making. Moreover, this role ambiguity is an added factor to this problem. When there is an absence of an understanding of the others' scope of work, such as a nurse not knowing that the pharmacist can alter medication dosages, a duplication of effort and absence of services problems can happen. Research indicates that role and leadership ambiguity are challenges reported by 69% of the healthcare workforce and this results in an inefficient patient care experience, for example, in the situation where the left hand does not know what the right hand is doing.

Physical Separation: The "Basement" Lab vs. The Clinical Ward

The design of a hospital, to a degree reflects the design of the thought of its administrators. The physical separation of team members is a problem in many organizations. Nurses and pharmacists usually work on the clinical floors where they have patient contact and can see each other. In contrast, the Laboratory is usually situated in the basement or a remote part of the building, which is far away from the clinical action.

The distance in sight between professionals in any given occupation leads to a lack of sight perspective of others leading to a loss in the relationship-building process9. For instance, a nurse cannot just step into the laboratory to inquire about the requirements of a sample. The laboratory technician does not know, just from observing, the ER bedlam that drives the mislabeling of a sample. The telephone voice of the laboratory professional becomes just that - a voice. The nurse simply becomes an order of commands in a computer. On the other hand, co-location of ward pharmacists with Point-Of-Care Testing (POCT) capabilities makes for a more collaborative scenario9. Without shared space, the collaboration becomes a machine with no grease to lose the system.

7.3 Interprofessional Education (IPE): Learning Together to Work Together

The foundation for the barriers faced currently lie in the training that healthcare professionals obtain which, in this case, is in isolation. For example, expecting lab scientists, pharmacists, and nurses to work collaboratively in a hospital environment after not having shared a class is a contradiction. Consequently, the Interprofessional

Education (IPE) void inhibits understanding of the roles, language and competencies of other professionals and leads to confusion in the workplace.

The WHO states that IPE happens "when two or more professions learn about, from and with each other." Without this, there is no 'collaborative practice-ready workforce'; it is merely an illusion. Siloed education is the breeding ground for misconceptions and stereotypes. For instance, a pharmacy graduate who never interacts with nursing students might think that nurses only give commands and do not assess. A nursing student might perceive the lab as just a box that is black, rather than a collaborative space housing a bunch of scientists. Siloed education will not be an issue only once we have IPE integrated early and strongly enough for students to learn to deal with complex clinical problems together before interacting with real patients.

7.4. The Impact of Burnout and Time Constraints

Exhaustion must also be recognized as a barrier. The modern healthcare system is a high-pressure one that is overworked and understaffed. Lack of time is a common barrier to collaboration.

Time is required for effective collaboration to take place. For a pharmacist who needs to explain a dose change, a walk to the nurses' station is time-consuming. So too is the time required for a lab scientist who needs to gently explain a sample rejection rather than simply clicking "reject" on the computer. When professionals are burnt out and time-constrained, they enter "survival mode," narrowing the focus to their individual tasks and ignoring the collaborative communication that integrates safety into the workflow. When organizational structures disregard this by not allowing protected time for interprofessional meetings, collaboration is destined for failure. The finite capacity for empathy and collaborative effort diminishes when chronically overworked. When the system overworks its people, the Triad collaps, and the patient is left hanging.

8. FUTURE HORIZONS AND TECHNOLOGY

The triad of Nursing-Pharmacy-Laboratory is being altered by the digital revolution. It is now the case that we are shifting from a reactive approach to a predictive one, assisted by data and technology.

8.1. Artificial Intelligence: The Fourth Team Member

Artificial intelligence and machine learning will be the "force multipliers" of the triad. If we consider the fact that AI does not sleep, and that it is extremely powerful, able to detect patterns that are not detectable by the human eye, one can see how powerful it could be. Rather, it is likely going to be the case that in a short while, AI will be able to analyze an electronic health record and incorporate relevant, real-time data that a nurse might be monitoring vis a vis vitals that are relevant to the laboratory data that is available and the pharmaceutical data that is available. A scenario that could occur is that a nurse will be able to be proactively contacted by an AI that would recognize the laboratory data, warrant a test to be ordered by the lab, and recommend a dosage be given by a

pharmacist. This indicates an evolution of the triad to the capabilities of prediction and prevention, rather than just detection in terms of the ability to prevent deterioration of a patient's health.

8.2. Electronic Health Records (EHR): The Digital Glue

The evolution of EHRs as more than an electronic storage device is necessary. The systems of the future, with full interoperability, will eliminate "data silos" once and for all. If a laboratory professional enters a critical value, it will no longer remain static in a database. It will activate a smart alert for pharmacy and nursing users, and a "command center" for patient care will be in place.

8.3. The Future of Home Care

The technology for hospital-at-home care is available. With the growing assortment of wearable technology and remote patient monitoring systems, the "bedside" is in the patient's home. Nurses will monitor patients through video feeds. With home Point-of-Care testing systems, patients can send lab data to the care team. Real-time medication adjustments will be available through pharmacy tele-consults. The triad of patient, nurse, and pharmacist will be joined, no longer confined to the walls of a hospital, but integrated by health care data flows.

9. CONCLUSION

The modern healthcare system cannot be understood by an individual profession alone. The research presented in this paper indicates that the safety and recovery of the patient rely on the integration of three separate but overlapping fields: Nursing, the Constant Presence and Advocate; Pharmacy, the Safeguard Strategist; and Laboratory Medicine, the Objective Sleuth of the Diagnosis.

While we have functioned in separate silos for long periods of time–separated by walls, learning, and hierarchy–the imperative of patient safety requires that these walls be dismantled. The Triad of Care is not an administrative construct; it is the human safety net that embraces the patient in times of greatest need. It is the nurse who draws the sample with care, the lab scientist who performs the critical tests, the pharmacist who tailors the dose with great skill; each of these individual actions of collaboration is an act of compassion.

Technology will improve and provide us with new tools, but care will always be human. It is the invisible communication, respect, and shared purpose between the three professions that ultimately saves lives. To care is to be collaborative, to cure is to be medical.

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