

Enhancing Clinical Collaboration: Interface Linking between Laboratories and Clinics for Translational Healthcare

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Abstract

Clinical laboratories are pivotal in modern healthcare, providing essential diagnostic information that influences patient management and healthcare efficiency. Technological advancements and economic pressures have continuously shaped laboratory medicine, leading to significant transformations in diagnostic capabilities. This article explores the evolving role of clinical laboratories, emphasizing their impact on disease prevention, early diagnosis, and patient safety. The discussion highlights the challenges faced by laboratory professionals, including test selection, result interpretation, and communication gaps between clinicians and laboratorians. Laboratory errors, classified into cognitive, systematic, and no-fault categories, are examined along with strategies to solve them. The importance of evidence-based laboratory medicine (EBLM), quality improvement initiatives, and inter-professional collaboration is not well understood. Furthermore, the integration of artificial intelligence in laboratory processes is considered a promising advancement, enhancing diagnostic accuracy and efficiency. The article concludes that encouraging effective communication and collaboration between laboratory personnel and clinicians is essential for optimizing patient care and ensuring the continued evolution of laboratory medicine.

Keywords: Clinical laboratory, Healthcare efficiency, Patient management, Communication, Education, Artificial Intelligence

Introduction

Clinical laboratories represent an area of healthcare that has always undergone major changes because of technological advances and external economic pressures. In the recent past, many new diagnostic techniques and laboratory tests have been introduced as a result of both research on the fundamental pathogenesis of diseases and the development of new methods in themselves. Lab transformation is inevitable, if we envision creating digital diagnostic network, enabling the connected world and empowering global health through impactful innovations. These advancements will allow us to build strategies in disease prevention and early diagnosis. The goal is to achieve progress in optimizing the health of the population in a sustainable and cost-effective manner.

Clinical Laboratory Services & Patient Care

Today's clinical laboratory (lab) is one of the hospital's

largest departments and provides about two-thirds of all objective information on patients' health status. It contains discrete departments for a variety of lab test types and houses sophisticated specialized instrumentation, thereby, providing vital information for effective healthcare delivery. The role of clinical biochemist or chemical pathologist or laboratory-based physician is being challenged on several fronts due to exponential advances in technology, increasing patient autonomy exercised in the right to directly request tests and the use of non-medical specialists as substitutes [1].

Clinical biochemical tests comprise over $\frac{1}{3}$ of all hospital laboratory investigations which are absolutely essential for medical practice by virtue of its varied roles at different levels such as: diagnosis and monitoring, prognosis of the disease, screening of disease or in assessing the response to treatment, research into the biochemical basis of disease, clinical trials of new drugs etc.

The contribution of laboratory services to clinical decision making not only depends on the performance of the laboratory itself, but also on the behaviour of clinicians with regard to requesting tests and using the results. Interpretation, leading to diagnosis and further assessment of required tests/treatment, is also integral which highlights the importance of Inter-professional collaboration and therefore, emphasize the factors that shape the interface, which may include responsibility, accountability, coordination, communication, cooperation, assertiveness, autonomy, mutual trust and respect [2]. Laboratory medicine professionals are the key component of patient safety. Thus, liaising with clinical colleagues to provide guidance on test results has an impact on evaluation, interpretation and follow-up, is required e.g. poor communication and integration between wards and laboratory may lead to delay in results and high expenditures. This can be improved by sharing patient records between the clinician and clinical laboratory personnel.

Further in today's era of personalised medicine, the laboratory is not just about the automation but also the science which has full impact on to the patient care and quality. Thus, the analytical reliability of laboratory tests is important. Laboratory errors affect the reliability of laboratory results [3]. Laboratory errors may be defined as "any defect from ordering of the tests to reporting results and appropriately interpreting and reacting on these results". Errors may occur in pre-analytical (65-70%), analytical (10-15%) and post-analytical processes (15-20%) of the total testing process e.g. interpretation of some tests (cortisol) is critically dependent on the time of day when the blood was sampled (circadian rhythm), or topping up a biochemistry tube with a haematology (potassium-ethylene diamine tetra-acetic acid, EDTA) sample will lead to high potassium and low calcium values. However, implementing methodologies like lean six sigma have a potential to reduce the pre-analytical error i.e. haemolysis from 9.8% to 0.88% as studied by Damato in 2015 [4]. As per the available literature, the lab errors can also be classified as Cognitive Errors (74%), Systematic Errors (65%), No Fault Errors (7%). Cognitive Errors are described as the failure to identify the available evidence, physical examination or test data appropriately or accurately. System errors are defined as the problems with coordination of care, communication between care givers or insufficient access to clinicians. No Fault Errors are those errors associated with process breakdown and therefore, leading to delay in reporting the test results. Some examples of these errors are asking diagnostic tests for further work-up, tracking of diagnostic information and performance and interpretation of diagnostic tests. Education and communication play a role in reducing these types of errors.

Patient Safety and Lab Test Selection

The patient safety errors associated with incorrect laboratory test selection and misinterpretation of test results have been largely unrecognized. Thus, clinics need a help mostly in the

area of appropriate test selection, test utilization and the correct interpretation of test results [5]. Improvement strategy should focus on physicians' test ordering behaviour through proper teaching strategies, ongoing audit and educational feedback, implementing health information technology tools and employing laboratory practice guidelines (LPGs) and testing algorithms. Steps to improve a two-way communication between clinicians and laboratory personnel will help in proper test selection and interpretation of test results. Conducting continuous quality improvement cycle for laboratory services and training of personnel involved in blood sampling is recommended for inefficient tests. The education and training should also incorporate practising state-of-the-art evidence-based laboratory medicine and clinical research. Another strategic approach to reduce the errors will be improvement to record the incidents encountered. Healthcare personnel should be encouraged to self-report the errors. This will help in identifying a pattern of errors, if any, and working consciously to minimize these errors.

Laboratory Professionals can expand their Consultative Role at the laboratory-clinical interface for better patient care and outcomes. A few initiatives which can help Improving adoption and adherence of evidence based laboratory medicine (EBLM) are as: UK NICE (National Institute for Health & Care Excellence) pathways that offer an interactive online clinical algorithm that is linked to detailed evidence-based information from diagnosis to treatment options; Norwegian Quality Improvement of Laboratory Services in Primary Care (NOKLUS), that circulate case-based scenarios to investigate appropriate test selection, test interpretation and medical decisions [6].

Even though Artificial intelligence (AI) in clinical laboratories looks enticing, still the number of AI tools that have been in use in a routine clinical laboratory are far and few. However, major challenges that are encountered while using artificial intelligence in clinical laboratories include validation of algorithm, legal accountability, lack of transparency, lack of data quality i.e. heterogeneity of data owing to different instruments, principles, units etc. Cost implications also limit the use of AI in clinical laboratories [7-9].

Following it up, we need to address "What is taught to students becoming physicians?" and "What are future doctors learning today about laboratory tests?". Thus, the teaching of laboratory medicine in medical schools is required to emphasize the "Test Selection" & "Test Interpretation" [10].

Unlike therapeutics, for which direct clinical effects can often be straightforwardly demonstrated, diagnostics provide information that indirectly influences patient management as well as the economic efficiency of healthcare systems. Thus, Investment in diagnostic information can be a key development as information may guide more effective, efficient and affordable healthcare system. This investment could be done in the form of online lectures to improve the

selection of test and interpretation of test e.g. ordering a genetic test to find mutations in a particular cancer could lead to a test resulting in discovering a mutation with unknown significance or a non-actionable gene mutation, thereby, resulting in wastage of resources, time and energy. Instead, a clinician should be made aware of the cancers where such a test would be of more value to the patient. Also, once a month inter-disciplinary meeting to discuss the patient cases, their interpretation of reports, further investigations would be helpful in-patient care. This is a form of collaborative training from which young generation of doctors will learn.

Conclusion

To conclude it is safe to say that despite so much innovations and advancements being done, it is important to have an effective two-way communication between clinical laboratory personnel and the clinician to provide a better patient care delivery.

Futuristic Approach

The future of the diagnostic testing lies in increasing the two-way interfacing between the clinician and the laboratorian at all the levels of a total diagnostic process [11]. This will increase the analytical and consultative role of the lab personnel in the patient care, as the laboratorian is in a better position to understand the complex test results and its interpretation [12]. Another important aspect in the future of lab diagnostics to improve the test accuracy and efficiency is by improving the role of Artificial intelligence (AI) in lab. Various algorithms are already in place which has decreased the human dependence in signing off the test results, thereby increasing the speed of test delivery with accuracy. But validation of these algorithms remains a big challenge. The future holds a promise of improvement in this aspect also as many researches are still ongoing [13].

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