World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 5.088

HOSPITAL SIDE LABORATORY TESTING: BRINGING DIAGNOSTIC TESTS NEARER TO THE PATIENT

***Tunji Akande**

Dept. of Chemical Pathology, Bingham University Jos Campus Nigeria.

***Corresponding Author: Tunji Akande**
Dept. of Chemical Pathology, Bingham University Jos Campus Nigeria.

Article Received on 11/06/2019 **Article Revised on 01/07/2019** **Article Accepted on 21/07/2019**

ABSTRACT
Background: There is a growing interest among clinicians in being able to perform an increasing range of diagnostic tests locally in a hospital ward side room or clinic physician office and intensive care units. **Objective:** To evaluate the side room tests commonly used to bring diagnostic tests nearer to the patient. **Method:** A review of simple chemical tests carried out on specimens of blood and urine to enable immediate clinical decision. **Results:** Commercially prepared reagent strips and tablets are simple to use and have replaced the "wet chemistry" methods that had for many years been the mainstay of side laboratory work. Large numbers of ward side laboratories now operate reliable solid phase chemistry systems by non-laboratory personnel after a limited amount of training. **Conclusion:** Side laboratory testing should be supported by the main laboratory of the Hospital to maintain the roles of these tests in near patient testing approaches to health care delivery. Introduction of sophisticated test into wards could be undertaken in a deliberate manner for successful operations.

KEYWORDS: Side Room, Diagnostic Testing, Near Patient, Hospital Wards.

1. INTRODUCTION

Hospital ward side room is a satellite laboratory located away from the central laboratory with one or several analysers operated by either laboratory or non-laboratory personnel.[1,2,3]

The purpose of installing such limited service laboratories is to provide adequate turnaround time (TAT) of test results by bringing the diagnostic service closer to the patient.[4,5] In the early days of diagnostic testing, tests were undertaken close to the patient at the point of care, integrating information gained from simple test into the clinician's observation of the patient's current symptoms and previous history.[6,7] Centralization of laboratory facilities as a result of development and availability of sophisticated analysers and analytical system has moved these simple tests away from the patients giving rise to the major problem of delay in obtaining test results.[8,9,10] The trend in the evolution of diagnostic testing from observation of the patient, through simple testing to sophisticated testing in the main laboratory eventually led to an increase in the TAT of test results from minutes to hours and sometimes days (Fig 1).[11,12] Recent development in diagnostic technologies have made possible miniaturization of large multichannel analyser components into small, portable handheld and transportable systems that could be used in hospital wards and critical care areas of the hospital.[13,14]

These technological developments have again made possible diagnostic testing at the point-of-care as was done in the past, providing results to the clinician without having to wait days or even hours for sample transport and laboratory processing.

This article reviewed the current place of clinical chemistry tests on specimens of blood urine and faeces, the potential value of recent developments in analytical systems that are able to be used in hospital ward and clinics.

2. Side Room Chemical Tests

These are tests which can be performed satisfactorily by non-laboratory staff including patients or their relatives at home after a limited amount of training. The tests in this category include dipstick or tablet reagent urinalysis, faecal occult blood, urine pregnancy test and blood glucose with approved monitoring devices.

The main roles of these side room tests are 1) as part of every complete clinical examination 2) as a follow-up of patients with diabetes mellitus, jaundice or renal tract disease; 3) and for screening programme.[15,16]

Tests for glucose and protein in urine are valuable in providing information additional to that obtained from the history and clinical examination. Similarly, side room

tests repeated periodically at follow-up examination may provide some of the earliest evidence of complications (e.g. glycosuria, proteinuria) developing in the course of an illness or as result of its treatment.

Several studies have shown that the best results with side room tests are obtained with the single test or limited multi-test strips.[17,18]

Occult blood in faeces for the detection of gastro intestinal blood loss may be very important for clinical diagnosis. The various chemical tests most of them nowadays supplied commercially all depend on the pseudo peroxidase activity of haem. All chemical tests for fecal occult blood give rise to false-positive and false negative results. False positive results often occur with more sensitive methods of detection and are serious as they can cause unnecessary further investigation with all the attendant worry.

False negative results occur with less sensitive tests and as such are dangerous because they give the clinician and the patient a misleading sense of security and can even cause delay diagnosis of potentially serious but initially curable conditions. Therefore, screening for carcinoma of the colon by occult blood tests may not be of much benefits.

Side room measurements of blood glucose with dipsticks are quick to perform and helpful in monitoring the control of diabetic patients on day-to-day basis. More precise results can be obtained under side room conditions by the use of systems with reflectance meters developed by the manufacturers (e.g. glucometer/glucostix from Ames Company and Reflocheck or Reflolux from Boehringer.[19,20]

3. Side Room Tests Methodology

It is possible to carry out an increasing range of biochemical tests on small, bench-top analysers or using dipstick methodology close to the patient either at the bedside, in the clinic or operation room or even in the home.[19,20]

Some of the tests which can be analysed on this basis include: 1) side room tests on urine and faeces. This is widely used for screening purposes in primary and secondary care. This includes the multistix range of tests which include glucose, protein, acetone, bilirubin and urobilinogen (Table 1).

The additional tests provided can to some extent be tailored to the location of instrument[21], for example a neonatal unit would require an instrument which deals with small volumes of samples and preferably provides electrolyte results, including calcium as well as lactate and bilirubin; 4) Blood gas analysers are widely used in acute settings in hospital such as accident and emergency department, acute admission unit and intensive care unit. Using appropriately trained staff and paying attention to quality issues results are generally excellent and allow multiple sampling on fresh blood samples in acutely sick patients or where frequent monitoring is necessary for management purposes (e.g. cardio-thoracic operations).[22]

The reliable operation of solid phase 'dry chemistry' systems by non-laboratory personnel requires strict adherence to the rules and the ability of staff to use them safely, reliably and responsibly and to maintain standards satisfactorily in long term operation, should be paramount factors to consider before installation of these system.

4. Solid Phase or Closed System Analysers

Advances in technology in clinical chemistry make use of reagents in a dry form for both qualitative and quantitative analysis.

We may expect in the near future analytical procedures for almost all current biochemical parameters will be available as solid phase chemistry tests. Although the solid phase chemistry tests were in fact developed as "laboratory tests" they also have potential as 'self' or 'home tests' especially for diabetic control.[23]

The development of test strips has given rise to two main types: 1) multiple layer film; 2) impregnated fibres. With the exception of ion-selective electrodes for measurements of K^+, Na^+, CL^- and CO_2, chemical reactions occurring on solid phase chemistry analyser are monitored by reflectance spectroscopy or fluorescence spectroscopy and more rarely by conductimetry.[24]

The widely used solid phase or closed-system analysers for performing chemical measurements on blood had been those developed for blood, plasma or serum glucose tests and blood gas studies. Recently there are now several commercially available systems with a much wider and progressively expanding repertoire of tests (e.g. Arnes seralyser and Boehringer Reflotron) other examples include the Ektachem 400 and 700 which are microprocessor-controlled automatic analysers.

There are desktop analysers to determine cholesterol triglyceride and HDL-cholesterol. Other parameters that can be assayed include creatinine, urea, glucose, bilirubin and haemoglobin (Table 2).

The reliable operation of solid phase 'dry chemistry' systems by non-laboratory personnel require strict adherence to the rules.

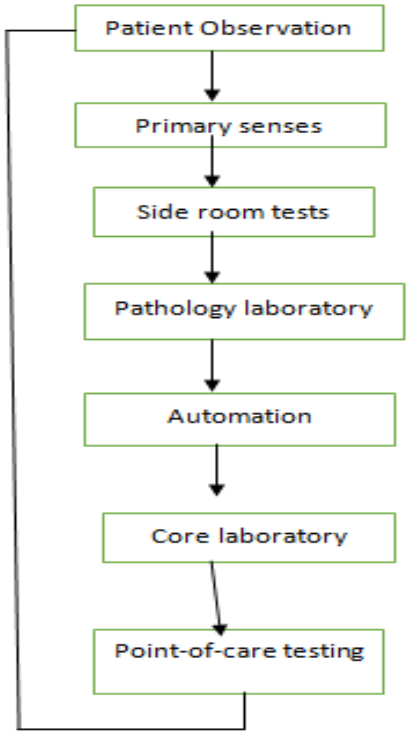
The ability of staff to use these instruments safely, reliably, responsibly and to maintain these standards satisfactorily in long-term operation should be paramount factors in their installation.

Table 1: Common tests on urine performed in the side room.

Analyte	Used when investigating
Protein	Renal disease
Glucose	Diabetes mellitus
Ketones	Diabetic ketoacidosis
PH	Renal tubular acidosis
Bilirubin	Liver disease and jaundice
Urobilinogen	Jaundice/haemolysis
Red cells/haemoglobin	Renal disease
HCG	Pregnancy

Table 2: Common tests on blood performed in side room.

Analyte	Used when investigating
Blood gases	Acid-base station
Glucose	Diabetes mellitus
Urea	Renal disease
Creatinine	Renal disease
Bilirubin	Neonatal jaundice
Therapeutic drugs	Compliance of toxicity
Salicylate	Detection of poisoning
Paracetamol	Detection of poisoning
Glucose	Diabetic monitoring
Cholesterol	Coronary heart diseases risk
Alcohol	Fitness to drive/confusion coma



***Adapted from*[6]**

(Fig 1): The Evolution of Diagnostic Testing.

CONCLUSION

With the re-emergence of the point-of-care testing, the hospital side laboratory testing has witnessed an increasing use of modern point-of-care instruments that allows prompt patient result turn around and thus the potential for speedy clinical management. This plays an important role in the management of Diabetes Mellitus with some patients testing their own blood glucose levels and adjusting their diabetic therapy accordingly. However, point-of-care testing also has potential problems and there should be close liaison with the hospital laboratory to ensure optimal usage.

REFERENCES

1. Creed GM. Point-of-care testing on the United Kingdom. Crit Care Nur Q., 2001; 24: 44-8.
2. Kammo N. coagulation monitoring in point of care testing: A global point of View. Rinsho Byori, 2002; 50: 1025-40.
3. Price CP. Point-of-care testing. BMJ, 2001; 322: 1285-8.
4. Bissel M. Point-of-care testing at the millennium. Crit Care Nurs Q, 2001; 24: 39-43.
5. Price CP. Regular reviewed, point-of-care testing. BMJ, 2001; 322: 1285-1288.
6. Burtis C, Ashwood E, Bruns D (eds): Tietz textbook of clinical chemistry and molecular diagnostic 4th ed. Philadelphia WB Saunders, 2006; 299-320.
7. Bishop M, Duben-Engle, Kirk J, Fody E (eds). Clinical chemistry; Principle, procedure correlation 5th ed. Philadelphia, Lippincott William and Wilkins, 2005: 168-177.
8. Akande T. Point-of-care testing (POCT). Implementation and management in Healthcare services. JAMMR, 2018; 27(8): 1-5.
9. Osreddkar J. Point-of-care testing in laboratory medicine. 2017 March Pp 1-27.
10. Price CP, St. John A, Hicks JM (Eds). Point-of-care testing, 2nd Ed, AACC press Washington DC 2004.
11. Mabey D, Peeling RW, Ustianowski A, Perkins MD. Diagnostic for the developing world. Nature Reviews, 2004; 2: 231-40.
12. Perling RW, Mabeg D. Point-of-care tests for diagnosing infections in the developing world Clin Microbiol Infect, 2010; 16: 1062-69.
13. Kost GJ. Principles and practice of point-of-care testing. Philadelphia: Lippincott, Williams and Wilkins, 2002.
14. Hay Burges DC, Wasserman J, Dahl CA. global Health Diagnostics. Nature, 2006; 144(suppl): 1-2.
15. Microfluidics-based diagnostic of infectious diseases in the developing world. Nature Med, 2011; 17: 1015-19.
16. National Institute of Health [Accessed 14 January, 2013]. A timeline of pregnancy testing.
17. Reisfield, Gary M, MD. University of Florida College of Medicine. AACC Virtual point of care conference. POCT in Pain Management" April 2015.
18. College of American Pathology "Point-of-care Testing Tool kit" September, 2013.
19. Post huma-Trumpre GA, Korf J, Van Amerongen A. Lateral flow immunoassay its strength, weaknesses, opportunities and threats: A literature survey Anal Bio anal Chem., 2009; 393: 569-82.
20. Oliver NS, Tonmazou C, Cass AE, Johnson DG. Glucose Sensors: a review of current and emerging technology diabet Med, 2009; 26: 197-210.
21. Tongushkina K, Nicholas JH. Glucose meters: a review of technical challenges to obtain accurate results. J. Diabete Sci Technol, 2009; 3: 971-80.
22. Rossi AF, Khan D. "Point of care testing: improving pediatric outcome" Clin Biochem, 2004; 37(6): 456-61.
23. Ordonez-Liamos J, Martinez-Couselo S, Fischer M, Koch P, Muser J. Multicentre performance evaluation of the cobas® b 101 point of care system [Abstract] AACC 2013 p.B53.
24. Scotland S, Lints P, Nicoll G, Barclay K, Baxter C, Archibald et al. evaluation of point-of-care (POC) prehospital testing for troponin (cTn1) while in Hospital transit via the Scottish ambulance service (SAS) – a preliminary study using the Samsung LABG 01B10 Analyzer [Abstract] AACC 2013 P B47.