Sudan University of Science and Technology
College of Graduate Studies

Evaluation of Analytical Performance of Chemistry Auto Analyzer A-15

تقويم الأداء التحليلي لمحلل الكيمياء التلقائي A-15

A dissertation Submitted in Partial Fulfilment for the Requirement of theDegree ofM.Sc. in Medical Laboratory Science (Clinical Chemistry)

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الآية

بسم الله الرحمن الرحيم

قال تعالى:

{*يَرْفَعِ اللَّهُ الَّذِينَ* آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ}

(صدق الله العظيم)

سورة المجادلة (رقم الآية 11)

Dedication

I dedicate my work

To my Parents who always give me love and care....

To those who help me more, my Teachers

Dr. Nasser Eldin M.A Shrif

To those whom I love more, and my Friends

To all people who love me

.

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Firstly, I thank Allah for blessing my life, and helped me to start This work and supported my strength to complete this humanity Work.
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for his constructive guidance, help and support me in each step to establish valuable and useful result.

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Abstract

Clinical Chemistry Laboratory are confronted with an ever-increasing workload with limited large-scale Medical Testing Laboratories, where turnaround-time (TAT) and lowest possible cost is a necessity to cater higher patient volume and wide range of Medical decision. Also, it allows enhanced repeatability or reproducibility, linearity, precision accurateness of patients results, in addition to over the course of twenty-four hours for a period of a week,**the aim of the study was** evaluate the analytical performance of A15 bio system automatic biochemistry.

data was analyzed by using the application of Excel.The evaluation of precisionwithin-laboratory Quality control materials of levels 1 and 2 were used for analyses. The repeatability and within-laboratory precision of the a-15 was evaluated using the 3 analytes. Quality control materials of each level were analysed twice on the same day (once in the morning and once in the afternoon) for 20 consecutive days. Evaluation of accuracy was done on 45 subjects with clinically significant values (distributed over the analytical measurement range) were used for analyses in accordance with the CLSI guideline EP05-A2.00 .The CVs of impressions for instrument using control material were below 1.19% ,0.60% ,1.40% respectively for urea, glucose and creatinine, with in run, between run and between day impression that for normal result ,and about high result of CVs which was 2.94% ,4.04% and 3.63% for urea within run ,between run and between day respectively ,1.5%,1,97% and 1.92% for glucose within run ,between run and between day impressions respectively. And about creatinine the CVs was 3.29% ,7.37% and 7.66% within run, between run and between day impressions respectively. The correlation coefficients for all 45 analytes were >0.975, suggesting that the two instruments produce comparably acceptable results.study conclude that evidenced good technical and analytical performance for A-15 clinical chemistry system. accuracy, precision, and correlation with our reference system demonstrated a good precision and reliability of Mindray, making this high throughput clinical chemistry system well suited for use in modern laboratories.

المستخلص

يواجه مختبر الكيمياء السريرية عبء العمل المتزايد بشكل متزايد مع مختبرات الفحص الطبي المحدودة على نطاق واسع، حيث يعد وقت العمل (TAT) وبأقل تكلفة ممكنة ضرورة لتلبية حجم المرضى الأكبر ومجموعة واسعة من القرارات الطبية .كما أنه يتيح إمكانية التكرار المحسنة أو التكرار، والخطية، ودقة دقة نتائج المرضى، بالإضافة إلى توفر ملف تعريف كيميائي للاختبار المختبري الرئيسي على مدار الساعة طوال أيام الأسبوع .هدفت الدراسة الي تقويم الأداء التحليلي للكيمياء الحيوية الأوتوماتيكية لنظام A15 الحيوي.

تم تحليلها باستخدام تطبيق Excel. تم استخدام تقييم الدقة داخل المختبرو مواد مراقبة الجودة من المستويين 1 و 2 للتحليلات. تم تقييم التكرار والدقة داخل المختبر من A-15 باستخدام التحليلات 3. تم تحليل مواد مراقبة الجودة من كل مستوى مرتين في نفس اليوم (مرة واحدة في الصباح ومرة بعد الظهر) لمدة 20 يومًا متتاليًا. وقد تم تقييم دقة على 45 شخصا مع قيم هامة سريريا (وزعت على نطاق القياس التحليلي) استخدمت للتحليلات وفقا للمبادئ التوجيهية CLSI EP05-A2.كانت النتيجة لمرات الظهور للأداة التي تستخدم مواد التحكم أقل من 1.19 ٪ ، 0.60 ٪ ، 1.40 ٪ على التوالي لليوريا والجلوكوز والكرياتينين ، مع المدى ، بين المدى وبين الانطباع النهاري عن النتيجة الطبيعية ، وعن نتيجة عالية التي كانت 2.94 ٪ ، 4.04 ٪ و 3.63 ٪ لليوريا في المدى ، بين المدى وبين اليوم على التوالي ، 1.5 ٪ ، 1،97 ٪ و 1.92 ٪ للجلوكوز في المدى ، وبين المدى وبين مرات الظهور اليوم على التوالي. وحول الكرياتينين كانت3.29 ٪ ، 7.37 ٪ و 7.66 ٪ داخل المدى ، بين المدى وبين ظهور اليوم على التوالي. كانت معاملات الارتباط لجميع تحليلات 45 > 0.975 ، مما يشير إلى أنالجهازين تنتج نتائج مقبولة نسبيا.خلصت الدراسة إلى أن الأداء الفني والتحليلي الجيد يدل على نظام الكيمياء السريرية A-15. أظهرت الدقة والدقيقة والارتباط مع نظامنا المرجعي دقة وموثوقية جيدة في Mindray ، مما يجعل نظام الكيمياء السريرية عالي الإنتاجية هذا مناسب تمامًا للاستخدام في المختبرات الحديثة

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List of abbreviations

Abbreviation	Term
QC	Quality Control
IQC	Internal Quality Control
EP05-A2.00	Evaluation of Precision Performance of QuantitativeMeasurement Methods; Approved Guideline—Second Edition
EQAS	External Quality Assurance Scheme
QA	Quality Assurance
SOPs	Standard Operating Procedures
SD	Standard Deviation
CV	Coefficient of Variation
CrCL	Creatinine Clearance
NABL	National Accreditation Board for Testing & Calibration Laboratories
CLSI	Clinical and Laboratory Standards Institute
CLIA	**Clinical Laboratory Improvement Amendments**
HCFA	Health Care Finance Administration
CAP	College of American Pathologists

PC	Performance Control
PID	proportional-integral-derivative
OGGT	Oral Glucose Tolerance Test

CHAPTR ONE

INTRODUCTION, RATIONALE & OBJECTIVES

Chapter One

Introduction, Rationale and Objectives

1.1Background

Analytical assessment of the analyzer and strategies should be done earlier than the creation of the brand-new analyzer into the routine use in an effort to affirm the declared specifications of the analytical technique. health care shipping is now not a simple system of inspecting the patient and giving him a prescription. over time there has been a speedy expansion inside the diverse branches of fitness care services. As a part of this enlargement manner and explosion of medical expertise, laboratory diagnosis has received splendid importance in contemporary exercise. (Hasan. 2008).

the usage of exceptional control (quality controls) the laboratory can make sure that the effects being issued by it are dependable sufficient to permit selections to be all for self-assurance. quality control is the study of those errors which can be the duty of the laboratory, and of the approaches used to recognize and decrease them. wrong laboratory consequences may additionally lead to incorrect management selections with probable deadly outcomes. The reliability of laboratory consequences is, therefore, most crucial. It is not sufficient to 'think' that 'my 'effects are exceptional. This has to be proved with medical evidence. Laboratory personnel need to understand that quality controls are an obligation to the affected person, that its miles designed to offer the analyst self-assurance inside the methods used and that its reason is not to discover scapegoats or to punish those making errors. (WHO.2000).

The A15 analyzer is a precision instrument. For this reason, special care must be taken with its installation and location. It is very important to connect the apparatus

and the associated computer to an appropriate electrical system. It must be as exclusive as possible and it must be earthed. (Othman*et al.*,2016).

Bio System A15 is a clinical auto analyzer specially designed for using as a main instrument in small laboratories and as a backup analyzer in medium sized and large laboratories. With A15 Biosystem gives you a complete system that integrates Biochemistry and Turbidimetry to achieve high performance. A15 is easily adaptable to any work routine because of its many configuration's options in the installations of samples and reagents. A15's Performance (low water consumption, minimal maintenance and significant savings in the use of consumables) optimizes the operational cost of the laboratory.(Farringto*et al.*,1995)

1.2 Rationale

The shifting chemistry parametric tests from one automation system to another automated arrangement requires the comparative analytical evaluations of analyzers, methods, calibration and precision testing of controls, both normal and pathological, before introduction of the equipment into the medical testing laboratory system so The control procedures can be developed to ensure the reliability of results used in patient care. Prospective purchasers, manufacturers, and to confirm declared specifications of the analytical method.

1.3 Objectives

1.3.1 General Objective

to evaluate the analytical performance of A15 bio system automatic biochemistry.

1.3.2 Specific Objective

To calculate precision using (within run-between day and total precision.

To determine accuracy of A15biosystem.

To compare performance of A15biosystem (to glucose, urea and creatinine analysis)with Mindray BA-88A.

CHAPTER TWO

LITERTURE REVIEW

Chapter Two

2. literature review

2.1Defining Quality

Quality means developing statements regarding the input, processes and outcome standards that the health care delivery system must meet for its population in order to achieve optimum health gains the general concept of quality means the measure of excellence or state of being free from defects, deficiencies and significant variations.

Quality is the result of several ongoing processes. It requires many individuals performing appropriate activities at the correct time during the plan development process. Quality control does not just consist of a review after a work product is completed.(Hamza et al.,2013)

2.2Defining Quality Control (QC)

The final inspection and testing of the finished product to ensure it is compliance with predetermined performance criteria.(Bartlett *et al,*.1994) QC procedures are critical to maintain and improve the accuracy, precision and reliability of the data produced in any laboratory analysis. These should be implemented in each laboratory to ensure that appropriate sampling and analytical procedures are followed, laboratory and field equipment are regularly checked and calibrated, and staff are adequately trained and supervised. QC checks are what a Laboratory does to ensure that its quality assurance program is working (Bartlett *et al,*.1994)

Quality Control on the other hand includes those activities that are undertaken to confirm that test and measurements results are accurate and reliable. These activities include, but are not limited to participation in proficiency tests and other

inter-laboratory comparisons, regular use of certified standard reference materials, secondary or sub-reference materials, in-house reference standards, testing or measurement of multiple samples (duplicates or replicates).(Hamza*et al.*,2013)

2.2.1 Internal and External Quality Control

Quality control measures employed to assess the analytical phase in a clinical chemistry laboratory are internal quality control (IQC) and external quality control (External Quality Assurance Scheme [EQAS]).

IQC is a sample material whose matrix is identical to the patients' sample and has an established concentration range available in two or three levels covering the medical decision points. The IQC is run as per NABL guidelines, interpreted using control charts such as Levy Jennings' and application of Westgard rules. IQC ensures a continuous watch of the analytical system, so as to check whether the results are reliable enough to be released. External quality control involves analyzing and reporting of control samples supplied by an external agency, at a predefined time interval which in Clinical chemistry is once a month. External quality control is interpreted by either Z-score or standard deviation index. A Z-score is a calculated value that tells us, as to how many standard deviations, a control result has shifted from the mean value which is expected for that material. The exact number of errors done by the laboratory in the analytical phase cannot be assessed by running internal and external QCs, but can be quantified by Sigma metrics.(Othman*et al.*,2016).

2.3 Defining Quality Assurance(QA)

Quality assurance is a systematic and planned approach to assessing, monitoring and improving the quality of health services on a continuous basis. It promotes confidence, improves communications and allows clearer understanding of

community needs and expectations. High quality health services do not mean luxury or "high-tech" services. As a health care provider giving attention to quality services is very essential for us whatever our resource maybe. A lot of QA change can occur without excess additional resources. Everyone is responsible for quality, from National down to individual level. (Farrington*et al.*,1995)

Quality assurance includes all the activities undertaken by a laboratory to ensure that reliable and accurate testing or measurement will be undertaken at all times. These activities include document control, laboratory internal audits, management review, sampling, handling and storage of samples, control of non-conforming work, complaints and corrective action procedures, technical and quality records.(Hamza*et al.*,2013)

2.4. Quality Assurance Programs

Are efficient ways of maintaining the standards of performance of diagnostic laboratories, and of upgrading those standards where necessary. quality goes beyond technical perfection to take into account the speed, cost, and usefulness or clinical relevance of the test. Laboratory tests in general are expensive and, with progress in medicine, they tend to use up an increasing proportion of the health budget (Farringto*et al.*,1995). Quality assurance is the sum of all those activities in which the laboratory is engaged to ensure that test results are of good quality.

The programme must be

- Comprehensive: To cover every step in the cycle from collecting the specimen to sending the final report to the doctor.
- Rational: To concentrate on the most critical steps in the cycle;
- Regular: To provide continuous monitoring of test procedures;

Frequent: To detect and correct errors as they occur.(Twicken*et al.*,2018).

Quality assurance (QA) in health laboratories incorporates all the factors that may influence the generation of reliable results. It comprises two key components. Internal quality control (IQC) includes appropriate measures taken during day-to-day activities to control all possible variables that can influence the outcome of laboratory results. This is a continuous process that operated concurrently with analysis. External quality assessment scheme (EQAS) is the other component. This component is necessary to ensure comparability of results among laboratories.(Twicken*et al.*,2018)

❖ 2.5Standard operating procedures

The preparation of test procedures comes under the broad heading of Standard Operating Procedures (SOPs). SOP is a clear, concise and comprehensive written instruction of a method or procedure which has been agreed upon and authorized as the operating policy of the department. In general, SOPs, which mainly contain detailed descriptions of each analytical method, are essential for maintaining the same analytical quality over a long period of time. The procedures are a prerequisite to correct transfer of methods from one laboratory to another. The contents of SOP are as follows:

- ❖ Introduction
- ❖ Principle of method
- ❖ Specimen types, collection and storage
- ❖ Reagents, standards and control - preparation and storage
- ❖ Equipment, glassware and other accessories
- ❖ Detailed procedure

2.5.1. Medical Laboratory Process

- Specimen collection (Pre-analytical)
- Specimen transport (Pre-analytical)
- Specimen receipt (Pre-analytical)
- Specimen processing (Pre-analytical)
- Testing (analytical)
- Interpretation (analytical)
- Reporting (Post-analytical).(Church *et al,* 2000)

2.6 Laboratory errors

Analytical errors are classified into random errors and systematic errors. It is clear that random errors indicate poor precision while systematic errors indicate poor accuracy. A few examples of random errors are pipetting error, transcription error, wrong sample numbering and labelling, and fluctuating readings on the colorimeter. Systematic errors could occur due to wrong procedure, incorrect standard and calibration procedure. Errors can occur in any of the limb of the cycle of events taking place in a hospital, starting from the physician examining the patient and back to the physician (preanalytical/ analytical/post-analytical). The physician, after examining the patient, decides and orders a test, and collects and transports the patient's samples; this constitutes the pre-analytical limb of the cycle of events. In the analytical limb the sample is received by the laboratory and analyzed. The post-analytical limb consists of the transfer of the result to the physician and a meaningful interpretation of the laboratory data by the physician, followed by necessary action. (Fuller*et al.*,2005).

2.6.1 Accuracy

is the degree of agreement between a measured value and its 'true/consensus'value. On the contrary, inaccuracy, which is represented by analytical bias, is defined as the % of the difference between the measured value and the 'true' value over the true value. Therefore, good accuracy means least analytical error. (Fuller*et al.*,2005).

2.6.2Precision

refers to reproducibility. It refers to the agreement between replicate measurements. It is quantitatively expressed as the standard deviation (SD) or more precisely as percent coefficient of variation (CV), which is defined as SD times 100 divided by the mean value of the results in a set of replicate measurements. Therefore, good precision means least CV(Fuller et*al* .,2005)

If a measurement is accurate, must it also be precise? Interestingly, the answer to this question is no, there are four possible combinations of accuracy and precision. The target at the far left shows both accuracy and precision as the shots are clustered together (they are precise) in the target's center-most ring (they are accurate). The next example shows results that are precise, due to a tight clustering of the shots, but inaccurate because they are at the target's outer edge instead of its center. The third example is considered accurate because the five shots cluster around the target's center, but they are not precise because the individual shots are quite far apart from each other. The final example shows a dispersion of shots that is both inaccurate and imprecise. Note that the average for a set of measurements may be accurate even if the individual measurements deviate significantly from the desired or theoretical value.

2.6.3 Factors affect accuracy and precision

Three main factors affect the accuracy and the precision of a measurement: the quality of the equipment we use to make the measurement, our ability to calibrate the equipment, and our skill using the equipment. We cannot make an accurate measurement if our equipment is not calibrated properly. To calibrate equipment, we analyze a system where the response is known to us and either adjust the equipment to give that response or determine the mathematical relationship between the measured result and its known value. In addition, the potential accuracy of any individual measurement is greater with better quality equipment or instrumentation; the better the scope, the closer each shot is to the target's center. (Mann *et al.*,2008)

2.7 Proficiency Testing

Proficiency testing had been shown to be a valuable tool for recognizing deficient laboratory performance long before passage of CLIA. In the mid-1940s, Sunderman and others operating clinical laboratories in Philadelphia, Pa., became concerned over incidents in which physicians had divided samples of blood and obtained substantially different results from different laboratories. Under the auspices of the Philadelphia County Medical Society, the first proficiency testing program was initiated. This program was so revealing of inadequacies that it became the impetus for organization of the CAP in 1946. Following CLIA 67, and later with passage of the Medicare Act and creation of the HCFA, the role of these organizations in conducting proficiency testing was expanded.(Hasan*et al,*.2008)

2.8 Quality Management

Are all activities of the overall management function that determine quality policy, objectives, and responsibilities, and implement them by means such as quality

planning, quality assurance, quality control, and quality improvement within the system (Haas, 2013). Always remember that: Success or failure of a quality system is dependent on the laboratory staff's: Knowledge, skills, motivation and Commitment.(Hasan*et al*,.2008)

2.9 A15 biosystem

The A15 analyzer is an automatic random-accessanalyzer specially designed for performing biochemical and turbidimetric clinical analyses. The instrument is controlled on-line in real time from an external dedicated PC. In each of the elements of the A15 analyzer, Biosystems has used leading edge technology to obtain optimum analytical performance, as well as taking into account economy, robustness, easy use and maintenance. A three-axis Cartesian operating arm prepares the reactions. Dispensing is performed by means of a pump with a ceramic piston via a detachable thermostatic needle. A washing station guarantees that the needle is kept perfectly clean throughout the process. The reactions take place in a thermostatic rotor in which absorbance readings are taken directly by means of an integrated optical system(Kusum*et al.*,2005).

According to manual contains the information required for learning about, maintaining and repairing the A15 automatic analyzer(WHO.2003). It should be used by the Technical Service as a learning and consultation document for the maintenance and repair of the instrument (Kusum*et al.*,2005).

2.9.1 General description of the analyzer

The A15 analyzer is made up of three basic elements: the operating arm, the dispensing system and the reading and reactions rotor. The electronic system of the instrument controls said elements and communicates with the external computer

containing the application program. Through this program, the user can control all the operations of the analyzer(Kusum*et al.*,2005).

2.9.1.1. Operating arm

This is a three-axis XYZ Cartesian mechanism. The X and Y axes move the dispensing needle over the analyzer horizontally and the Z axis moves it vertically. It is operated by three step-by-step motors. In each 24-second preparation cycle, the operating arm performs the following actions: first of all, it sucks in the reagent from the corresponding bottle. Next, the needle is washed externally in the washing station and sucks in the sample from the corresponding tube. It is washed externally again and dispenses the sample and the reagent into the reaction's rotor. Finally, it is exhaustively washed internally and externally before proceeding with the next preparation. The arm has a system for controlling vertical movement to detect whether or not the needle has collided into anything on descending. If a collision occurs, as may be the case if, for example, a lid has been left on a bottle of reagent, the arm automatically restarts, verifies the straightness of the needle and continues working issuing the corresponding alert to the user. A vertical axis retention system prevents the needle from falling in the case of a power cut, avoiding injury from the needle to the user or the needle being bent by an attempt to move the arm manually. The operating arm only makes the preparations if the general cover of the analyzer is closed. If the cover is raised while it is functioning, the arm automatically aborts the task in progress and returns to its parked position to avoid injury to the user.(Kusum*et al.*,2005).

2.9.1.2Dispensing system

This system consists of a thermostatic needle, supported and displaced by an operating arm and connected to a dispensing pump. The needle is detachable to enable cleaning and replacement. The analyzer has capacity level detection to control the level of the bottles and tubes and prevent the needle from penetrating too far into the corresponding liquids, thus minimizing contamination. An automatic adjustment system informs the user if the needle is not mounted or if it is too bent. The needle has a sophisticated Peltier thematizations system, with PID control, capable of thermosetting the preparations at approximately 37º in less than 15 seconds. Dispensing is carried out by means of a low maintenance ceramic piston pump driven by a step-by-step motor. It is capable of dispensing between 3 and 1250 ml. The exterior of the needle is kept constantly clean by a wash station included in the base. A membrane pump transports the waste to the corresponding container. The A15 analyzer has a tray with 4 free positions for racks of reagents or samples. Each reagents rack can carry up to 10 reagents in 20 ml or 50 ml bottles. Each samples rack can contain up to 24 tubes of samples. The samples can be patients, calibrators or controls. The analyzer can be configured to work with 13 mm or 15 mm diameter tubes of samples with a length of up to 100 mm or with pediatric wells. Any possible configuration of racks can be mounted from 1 rack of reagents (10 reagents) and 3 racks of samples (72 samples) to 3 racks of reagents (30 reagents) and 1 rack of samples (24 samples) (Kusum*et al.*,2005).

2.9.1.3 Reactions rotor and reading

The preparations are dispensed in an optical quality methacrylate reactions rotor thermostatic at 37ºC. The optical absorbance readings are taken directly on this rotor. Each reaction can be read for 10 minutes. The readings are taken as they are programmed in each measurement procedure. The reaction wells have been

designed to enable the mixture of the sample and the reagent during the dispensing. Each rotor has 120 reaction wells. The length of the light path is 6 mm. The minimum volume required to take the optical reading is 200 uL. The wells have a maximum useful capacity of 800 uL. When the reactions rotor is completely full, the user must change it for one that is empty, clean and dry. The reactions rotors can be reused up to 5 times if they are carefully cleaned immediately after use. The Cleaning the semi-disposable reactions rotor section in the Installation and maintenance manual describes how to clean the rotors. The user has a test in the computer programme, which he or she may use to check the condition of the rotor. The rotor is driven by a step-by-step motor with a transmission. A Peltier system with PID control thermostats the rotor at 37ºC (Wangchuk, P. 2016).

2.9.2 Functioning of theA15 biosystem- analyzer

The A15 analyzer is an automatic random-accessanalyzer specially designed for performing biochemical and turbidimetric clinical analyses. The analyzer performs patient-by-patient analyses and enables the continual introduction of samples. The analyzer is controlled from a dedicated PC that is permanently communicated to the instrument. The programme, installed on the computer, keeps the user constantly informed of the status of the analyzer and the progress of the analyses. As results are obtained, the computer shows them to the user immediately. When a Work Session is begun, the analyzer proposes performing the blanks, calibrators and controls programmed for the measurement procedures it is to carry out. The user may choose between performing the blanks and the calibrators or not. If they are not performed, the analyzer uses the last available memorized data. The controls can also be activated or not. During a session, while the analyzer is working, the user can introduce new normal or urgent samples to be analyzed. Each time a new sample is added, the analyzer automatically proposes the possible

new blanks, calibrators or controls to be performed. A work session can remain open for one or more days. When a session is closed and another new session is opened (Reset Session), the analyzer again proposes performing the blanks, calibrators and controls. It is recommended that the session is reset each working day. (Kusum*et al.*,2005).

2.9.1.4 Application program

The application program makes it possible to control all the operations of the analyzer. From this program, the user can monitor the state of the analyzer and the work session, program parameters, e.g. technique parameters, prepare the work session, prepare results reports, configure different analyzer options, activate various test utilities, prepare and maintain the instrument and carry out internal quality control processes. The purpose of this manual is not to explain the functioning of the user program. (Kusum*et al.*,2005).

2.10 Creatinine

measuring serum creatinine is a simple test and it is the most commonly used indicator of renal function. A rise in blood creatinine level is observed only with marked damage to functioning nephrons. Therefore, this test is not suitable for detecting early-stage kidney disease. A better estimation of kidney function is given by the creatinine clearance (CrCl) test.A normal result is 0.7 to 1.3 mg/dL for men and 0.6 to 1.1 mg/dL for women.Females usually have a lower creatinine than males, because they usually have less muscle mass.(Renauer*et al.*, 1995)

2.11 Urea

Urea is the end product of protein catabolism. The urea is produced from the amino group of the amino acids and is produced in the liver by means of the Urea cycle.(Westgard *et al*,.2003). Urea undergoes filtrations at the glomerulus as well

as secretion and re absorption at the tubular level. The rise in the level of serum urea is generally seen as a marker of renal dysfunction especially glomerular dysfunction. Urea level only rises when the glomerular function is reduced below 50%. The normal serum urea level is between 20-45 mg/dl. But the level may also be affected by diet as well as certain non-kidney related disorders. (Westgard *et al,*. 2003).

2.12. Glucose

is the major carbohydrate present in the peripheral blood. Oxidation of glucose is the major source of cellular energy in the body. Glucose derived from dietary sources is converted to glycogen for storage in the liver or to fatty acids for storage in adipose tissue. The concentration of glucose in blood is controlled within narrow limits by many hormones, the most important of which are produced by the pancreas. The most frequent cause of hyperglycemia is diabetes mellitus resulting from a deficiency in insulin secretion or action. Random plasma glucose > = 200 mg/dl (11.1 mmol/L) Fasting plasma glucose > = 126mg/dl (7.0mmol/L) .Two-hour plasma glucose > = 200 mg/dl (11.1mmo/L) during an OGTT (75-g glucose load) An intermediate group who did not meet the criteria of diabetes mellitus but who had glucose level above normal was defined by two methods :• Fasting glucose levels >= 110 mg/dl but < 126 mg/dl were called the impaired fasting glucose group ,Patients who had 2-hour OGTT levels of > = 140 mg/dl but < 200 mg/dl was defined as impaired glucose tolerance. (Bishop., 2013).

2.12Previous study

there was no similar study was done to evaluate the analytical performance of A15 bio system automatic biochemistry.

CHAPTER THREE

MATERIAL & METHODS

Chapter Three

Material and Methods

3.1 Study Design

This was comparative study.

3.2 Study Area

This study was conducted in Atbara State during the period from March 2019 to April 2019.

3.3 Study Populations:

The study included 45 sample of three analytes (glucose, urea and creatinine) to assess the analytical performance of analytes determined on biosystem A15 chemistry analyzer.

3.4Data analysis:

Excel 2010 (Microsoft Co., Redmond, WA, USA) was used to calculate the mean, standard deviation, and coefficient of variation (CV) at each level of quality control material. Linear regression analysis was used to calculate the slope and intercept of the regressed line.

3.5Samples Collection and Processing:

the tested analytes were as follows: glucose, creatinine (Creat), urea, Testing was conducted at Atbara hospital to validate the complete analytical performance of the analyzer, for each method that analyzer performs.

A commercial control samples of human origin (Control Serum Level 1 (as normal control), Control Serum Level 2 and add 5 ml of D.W and divided into 20 each in test tube for precision , for accuracy collected 45 sample and

divided 15 for glucose ,urea and creatinine respectively and read them ,repeated the reading by used Mindray and recorded results ,Calibrations for the tested analytes were performed using recommended procedures for the evaluated analyzer, using the original calibrators ,analytical evaluation of analyzer included the determination of within-run and between-run imprecision , inaccuracy (comparing to the declared values of the control sample) and methods Within-run and between-run imprecision were used to determine the extent of random error and accuracy (bias) was used to detect the extent of systematic error affecting the measurement , Between-run imprecision was determined measuring the concentration of analytes in the control sera of different concentration ranges (Level 1, Level 2) in duplicate during the period of 20 days. Imprecision was expressed as the mean and the coefficient of variation (CV %). Within-run imprecision was determined in duplicate on 20 consecutive measurements of different analyte concentrations in control sera (Level 1, Level 2) and also expressed as a coefficient of variation (CV%).

The EP05-A2 protocol: The assessment was performed on at least two levels, as precision can differ over the analytical range of an assay. Each level was run in duplicate, with two runs per day over 20 days, and each run separated by a minimum of two hours. at least one quality control (QC) sample in each run. If QC material is being used for the precision assessment, it should be different to that used to control the assay. The order of analysis of test materials and QC for each run or day were changed. The simulate actual operation, include at least ten patient samples in each run. (Chesher, D. 2008).

3.6Methods

3.6.1 evaluation of precisionwithin-laboratory Quality control materials of levels 1 and 2 were used for analyses. The repeatability and within-laboratory precision of the A-15 was evaluated using the 3 analytes. Quality control materials of each level were analyzed twice on the same day (once in the morning and once in the afternoon) for 20 consecutive days. The results were evaluated according to the Clinical Laboratory Standards Institute (CLSI) guideline EP05-A2 (Budd*et al.*,2013).

3.6.2 evaluation of Accuracy

Sera from at least 45 subjects with clinically significant values (distributed over the analytical measurement range) were used for analyses in accordance with the CLSI guidelineThis study was performed in 2019. The biosystem A15 and Mindray was evaluated for its precision and accuracy, the tested analytes were as follows: glucose, creatinine (Creat), urea, Testing was conducted at Atbara hospital to validate the complete analytical performance of the analyzer, for each method that analyzer performs.

EP05-A2. A comparison study was performed between the A15 Analyzer and mindary BA-88A. The concentration of each analyte was measured using the two instruments, within a two-hour period. The mean values were used for regression analyses and for calculating the correlation coefficient (r).

3.7 Quality control:

The precision and accuracy of all methods used in this study were checked at least once per day with commercially available control, was done at least two levels of control (normal and abnormal).

CHAPTER FOUR

RESULTS

Chapter Four

Results

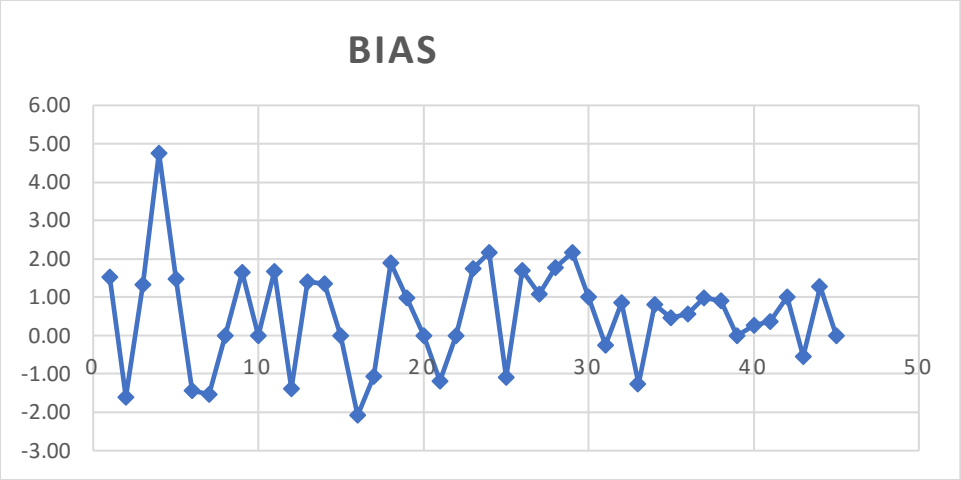
Table (1): Impression evaluation profile of (instrument) for level 1 control material

analyte	unit	within run		between run		between day		total	
		SD	CV %	SD	CV %	SD	CV %	SD	CV%
Urea (normal)	Mg/dl	0.32	1.19	0.76	2.84	1.53	5.70	1.64	6.10
Urea (high)	Mg/dl	3.65	2.94	5.03	4.04	4.51	3.63	6.30	5.07
Glucose(normal)	Mg/dl	0.56	0.60	1.70	1.82	1.66	1.78	2.09	2.24
Glucose (high)	Mg/dl	4.19	1.51	5.47	1.97	5.34	1.92	7.23	2.61
Creatinine(normal)	Mg/dl	0.02	1.40	0.09	5.34	0.21	12.87	0.22	13.44
Creatinine (high)	Mg/dl	0.17	3.29	0.37	7.37	0.39	7.66	0.49	9.55

The precision evaluation was conducted according toAbbreviation: SD, CV

Table (2): correlation between CV of (Urea, Glucose and creatinine with in run and CV of kits and CV of kits high.

analyte	unit	within run		Diff	CV of Kits of N	Total diff	CV of Kits of H
		CV (normal)%	CV (high)%	CV %	CV%	CV%	CV%
Urea	Mg/dl	1.19	2.94	1.75	1.6	0.15	0.8%
Glucose	Mg/dl	0.6	1.51	0.91	1.0	0.09	0.9%
Creatinine	Mg/dl	1.4	3.29	1.89	2.9	1.01	1.2%



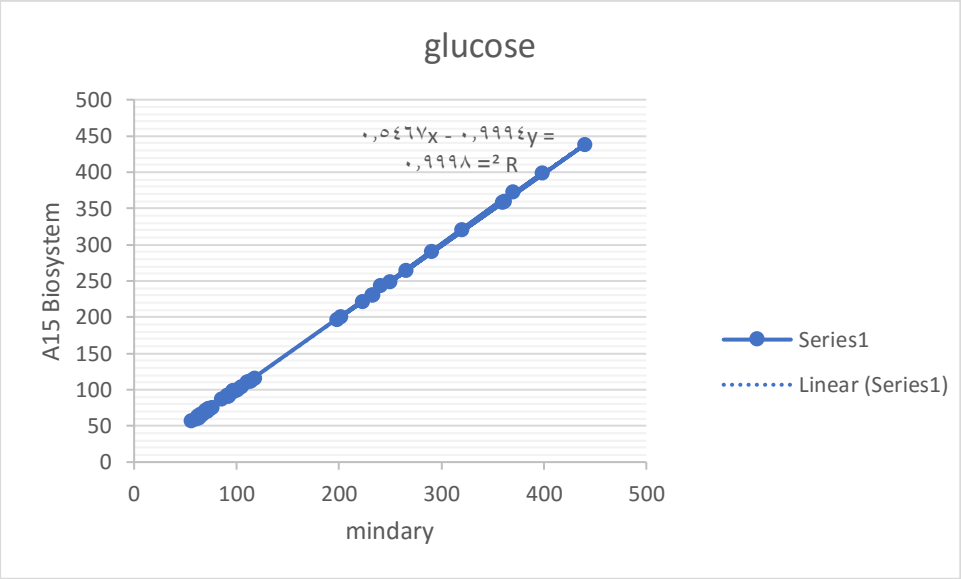
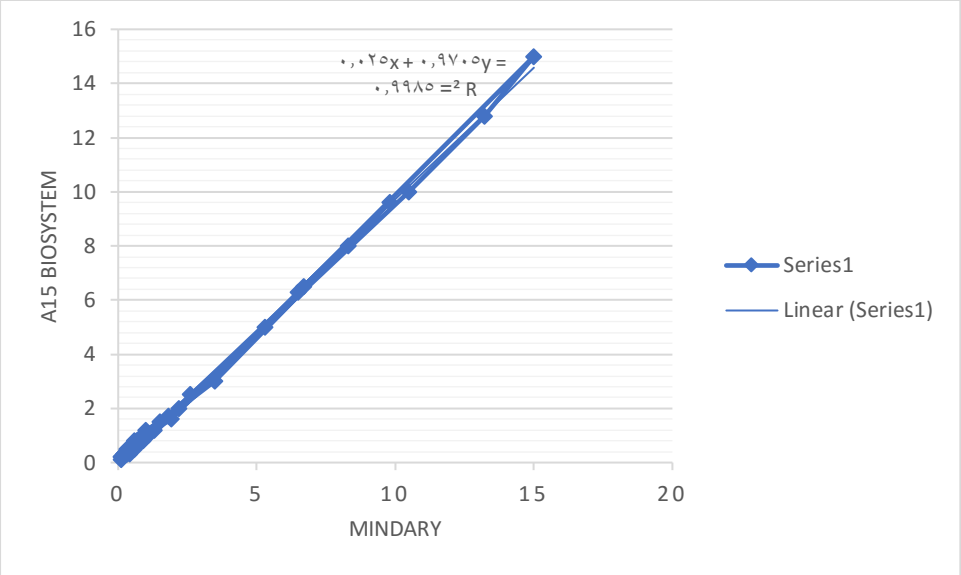


Fig (4.1): A scatter plot of Glucose and the corresponding regression line and regression equation for the relationship between the dependent variable A15 biosystem and the independent variable Mindray. r = Pearsons's correlation coefficient R-squared linear = coefficient of determination. There was strong positive relationship of glucose by using A15 and Mindray.



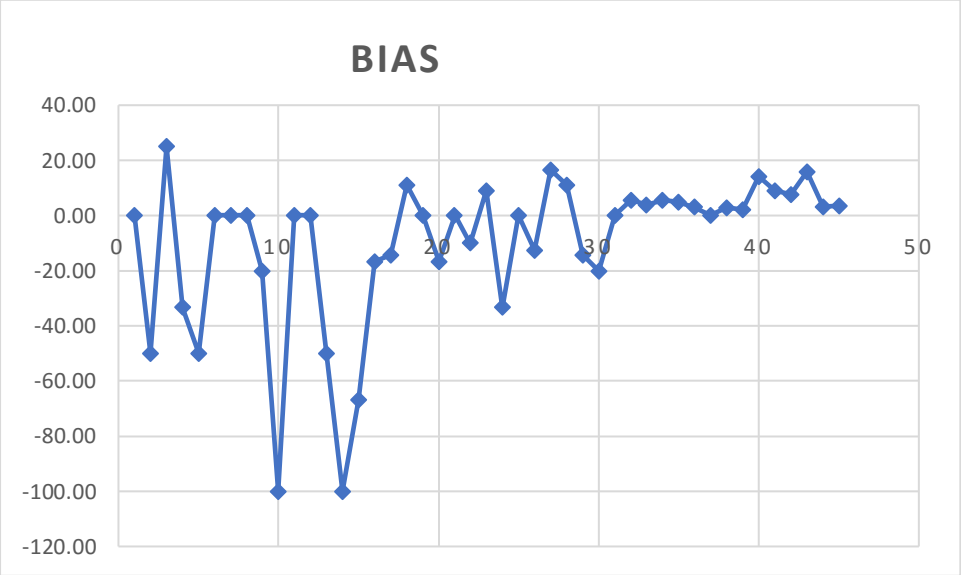
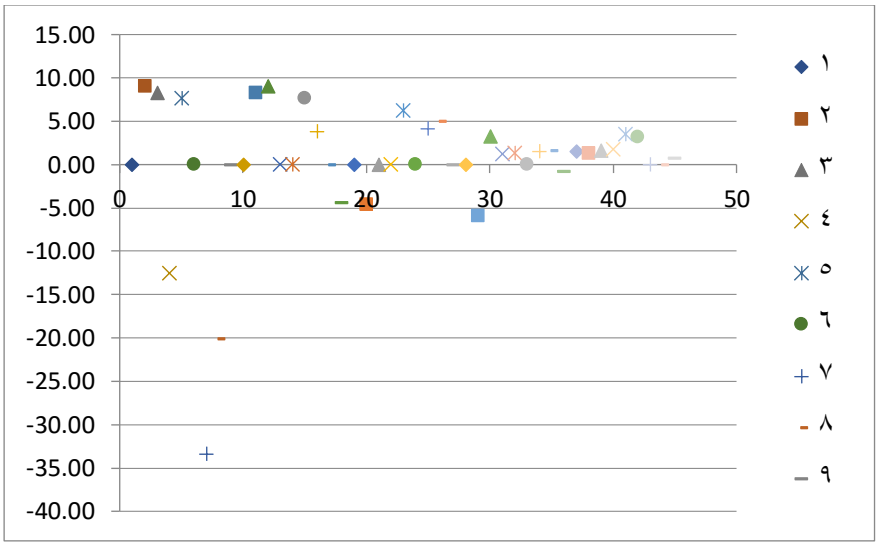


Fig (4.2): A scatter plot of creatinine and the corresponding regression line and regression equation for the relationship between the dependent variable A15 biosystem and the independent variable Mindray. r = Pearsons's correlation coefficient R-squared linear = coefficient of determination. There was strong positive relationship of creatinine by using A15 and Mindray.



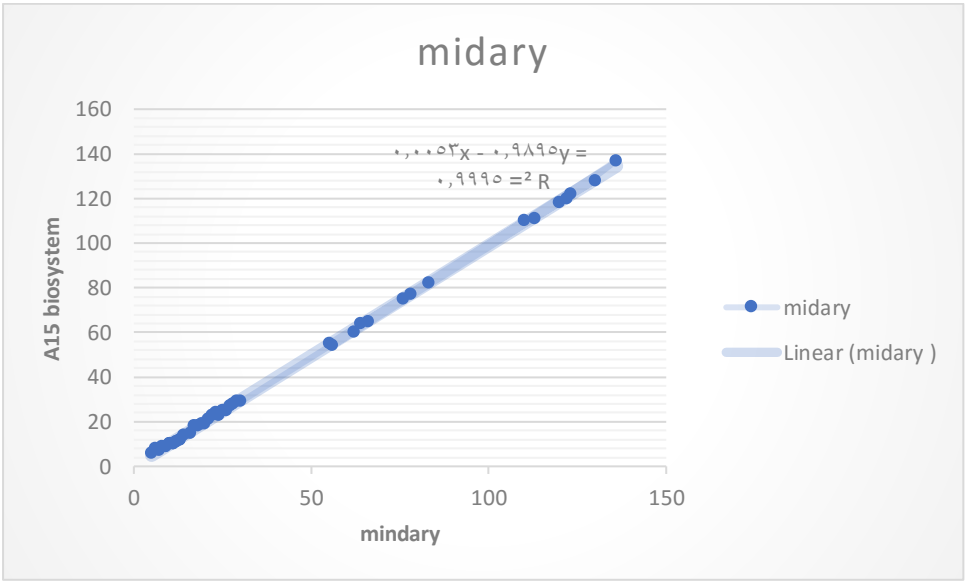


Fig (4.3): A scatter plot of urea and the corresponding regression line and regression equation for the relationship between the dependent variable A15 biosystem and the independent variable Mindray. r = Pearsons's correlation coefficient R-squared linear = coefficient of determination. There was strong positive relationship of urea by using A15 and Mindray.

CHAPTER FIVE

DISSCUSSION and CONCLUSION &

RECOMMENDATION & REFRENCE

Chapter Five

Discussion, conclusion and Recommendation

5.1Discussion

The analysis of hospitals quality based on their performance measures plays an important role for practical use. However, misclassification might occur when dealing with ranking. At present there is very little literature on studies concerning quality of classification machine. The main objective of this thesis is to assess and investigate the quality of two different methods. Comparison among different methods is performed by using precision and accuracy to compare between them.

This is comparative study conducted in Atbara hospital from 23/3/2019 to23/4/2019 to assess the analytical performance of analytes determined on biosystem A15 chemistry analyzer, the results of this analytical validation showed acceptable coefficients of variation for day-to-day imprecision, within-run imprecision depending on the measurement procedure. Collected data were analyzed by statistical package of social science (SPSS) program, the results revealed the following: Acceptable result in control with urea, glucose, creatinine.

The CVs of impressions for instrument using control material were below 1.19% ,0.60% ,1.40% respectively for urea, glucose and creatinine, with in run, between run and between day impression that for normal result ,and about high result of CVs which was 2.94% ,4.04% and 3.63% for urea within run ,between run and between day respectively ,1.5%,1,97% and 1.92% for glucose within run ,between run and between day impressions respectively. And about creatinine the CVs was 3.29% ,7.37% and 7.66% within run, between run and between day impressions respectively. Our study agreement with other done by Baisong et al.,2013.

sample was measure carry over performance over the duration of the run. The carryover was assessed by calculating by the analyte response in the blank sample as a percentage of the mean response from the preceding15 standard samples.

The data was first visually analyzed on the XY graph to identify extreme nonlinearity or outliers. regression analysis was also performed for first-, second-, and third-order polynomials to determine whether any nonlinear coefficient was significantly different. In this study, none of the nonlinear coefficients was observed to be significantly different. The CLSI guideline EP6-A states that the goals for linearity should be less than or equal to the goals for bias. Thus, the goals for bias should be less than or equal to goals for measurement error.

In the current study when compare between CV% of Urea within run was 1.6% was lower than CV% of Control normal urea 1.6 %. and the CV% of Urea between run was 2.84 % was higher than CV% of Control normal urea 1.6 %.These results were also acceptable. The CV% of creatinine within run was 1.40% was lower than CV% of Control normal creatinine 2.9%. and the CV% of creatinine between run was 5.34 % was higher than CV% of Control normal glucose 2.9 %.These results were also acceptable because the CV were within the ranges, and the CV% of Glucose within run was 0.60% was lower than CV% of control normal glucose 1.2% and the CV% of glucose between run was high was 1.8%.These results were also acceptable.

In the present study We compared the performances of the Mindray and a15 biosystem. The slopes (Y) ranged between 0.999 ,0.970 and 0.989, and correlation coefficients (r) between 0.999 ,998 and 0.999for glucose, creatinine and urea (Fig.

1 fig 2 and fig 3). The correlation coefficients for all 45 analytes were >0.975, suggesting that the two instruments produce comparably acceptable results.

5.2 Conclusion

Our study evidenced good technical and analytical performance for A-15 clinical chemistry system. accuracy, imprecision, and correlation with our reference system demonstrated a good precision and reliability of Mindray, making this high throughput clinical chemistry system well suited for use in modern laboratories.

5.3 Recommendation

-Designed Cohort study

-Increase sample size

-Increase parameter

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Appendices

A-15 Biosystem

BA- 88A