

## Impact and Challenges of Electronic Services and Devices on Medical Laboratory Practice; A Study in the Central Region of Ghana

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### Abstract

**Background:** The introduction of electronic services and devices has led to rapid and dramatic innovation and development in the laboratory environment. However, despite the numerous achievements and contributions in the health sector, laboratory practice continues to encounter certain difficulties in the use of electronic services and devices.

**Objective:** This study examined the challenges medical laboratory personnel face in the use of electronic services and devices, and its impact on the attitude of medical laboratory personnel.

**Methods:** A total of 62 medical laboratory personnel were conveniently selected from 8 hospitals within the Central region of Ghana. A questionnaire on Electronic Medical Laboratory Personnel Services for Efficient Health Delivery Services in Ghana was used to collect data for the study. Data collected were screened, coded and entered into computer software, and analysed using the Statistical Package for Social Sciences (SPSS version 21) for Windows.

**Results:** Findings revealed that the supply of electronic device accessories such as reagent was a challenge as only 37.1% of the respondents agreed it was easy. About 15% responded that maintenance/servicing of electronic device was easy. Majority showed positive attitude towards the operation of electronic device understanding principle under which electronic devices work. A higher proportion of the respondents agreed to the fact that results produced by electronic device are reliable, with average duration of producing being minutes indicating a better turnaround times. The use of electronic services and devices in the medical laboratory has had a positive impact on the attitude of some medical laboratory personnel.

**Conclusion:** Maintenance and repair works on electronic devices by maintenance/service team have to be prompt and regular. Workshops and training should be organized on use of electronic services and devices on regular basis for medical laboratory personnel so they could be abreast with current trends in their usage.

**Keywords:** *Electronic services and devices; Laboratory; Medical laboratory personnel*

## Introduction

The use of medical laboratory tests to detect, diagnose, monitor and treat disease keeps on increasing day by day. The results produced by medical laboratory tests are used by physicians to make decisions regarding a patient's medical condition. Some sources estimate that 70-80% of decisions made by physicians are directly dependent on medical laboratory values (Wians, 2009). According to Plebani (2002), contribution to modern medicine by laboratories has been recognized as something more than the addition of another resource to medical science and is now being regarded as the seat of modern medicine, where physicians account for what they observe in their patients.

As stated by Burke (2000), the emergence of sophisticated automated laboratory machines with complex procedures and the laboratories that housed them coincided with the worldwide political, industrial and philosophical revolutions. These have transformed our world which was dominated by religion and aristocracy into those dominated by the industrial, commercial and professional classes. Years after years, laboratories and their heads were met with opposition especially those clinicians who did not understand their work and saw their profession as a threat to science. However, as they continuously practice this profession, lay people and many health practitioners saw the introduction of medicine in the laboratory as a removal of medical knowledge from the realm of common experience to that of evidence based.

Recently, with the introduction of electronic services and devices, the laboratory environment has experienced rapid and dramatic innovation and development (Bossuyt, et al., 2007). There has been a significant increase in the variety and nature of medical laboratory investigations and services. This is due to technology and it is expected to continue. This has made laboratory technology according to Bossuyt, et al. (2007), the forefront of medical advances. Testing techniques to diagnose or screen for a particular condition are now available before effective treatment. According to Chapman (2003), advance in medical laboratory technology involving new tests, automated equipment and testing technique has resulted in a more efficient laboratory testing. As stated by Chaudhry, et al. (2006), information technology has also influenced the transfer of data by decreasing the time it takes to request for and receive test results and also by creating opportunities for research on large datasets. The integration of electronic services into medical laboratory practice may be affected by policies related to training of personnel, attitude of personnel, coverage and finally payment of services.

Ghana was celebrated in 2013 for hosting five out of the nine state owned ISO laboratories in West Africa. Besides these ISO laboratories, there are numerous laboratories spread along the length and breadth of the country which function in hospitals, clinics just like strategically positioned private laboratories (citifmonline, 2016). All these achievements are through the efforts of the scientists and the introduction of modern technology.

However, despite the numerous achievements and contributions in the health sector in disease diagnosis, prevention, managements and prognosis, laboratory practice continues to encounter certain difficulties in the use of electronic services and devices. Therefore, this study examined the challenges medical laboratory personnel face in the use of electronic services and device and their impact on the attitude of medical laboratory personnel in the Central Region of Ghana.

## Materials and Methods

### Research Design and Site

A cross-sectional study with quantitative approach was conducted in the Central Region of Ghana. The Central Region is one of the ten administrative regions of Ghana. It is renowned for its many elite higher education institutions and an economy based on an abundance of tourist sites. There are seventeen districts in the region with each district having a health directorate and a district hospital and many health centers. There are also some mission and private hospitals in the region. The region has a regional hospital and a teaching hospital which attend to referral cases from the district hospitals and other health facilities. All these health facilities have medical laboratories which are in full operation with different categories of medical laboratory personnel performing various functions. The district, municipal, teaching, mission and some private hospitals have laboratories which make use of electronic services and devices in the running of patient sample. The laboratories included Cape Coast teaching hospital, Winneba and Swedru Municipal Hospitals and Kasoa District Hospital. The mission and private laboratories selected were Apam Catholic Hospital, St. Joos Hospital, MDS Lancet and Sanford Hospital.

### Population

The target population for this study was all medical laboratory personnel in the central region who make use of electronic services and devices in their daily practice.

### Sampling procedure

Convenience sampling method was used to choose the sample. Convenience sampling according to Dörnyei (2007), is a type of non-probability or non-random sampling where members of the target population that meet certain practical criteria such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study.

The researcher adapted convenience sampling method for this study because it was assumed that most of the staff from these laboratories either had a degree or an HND and were licensed and certified by the Allied Health Council of Ghana to use electronic services and devices. It was also assumed that personnel were also easy to reach and were readily available. It was assumed that convenience method placed primary emphasis on generalizability, thus ensuring that the knowledge gained was representative of the population from which the sample was drawn.

### Sample size

In this study, a sample of 62 medical laboratory personnel were conveniently selected from Cape Coast Teaching Hospital, Winneba and Swedru Municipal Hospitals, Kasoa District Hospital, Apam Catholic Hospital, St. Joos Hospital, MDS Lancet and Sanford Hospital. Out of the 62 laboratory personnel that were sampled, 6 came from medical laboratories in the teaching hospital, 14 from laboratories in municipal hospitals, 13 from district hospital laboratories, 14 from mission hospital laboratories and the remaining 15 from private medical laboratories. These laboratories were used because it was observed that they have the highest number of laboratory personnel who use electronic services and devices in the region.

### Research Instrument

A questionnaire on Electronic Medical Laboratory Personnel Services for Efficient Health Delivery Services in Ghana was used to collect data for the study. A questionnaire: Electronic Medical Laboratory Personnel Services for Efficient Health Delivery Services in Ghana (Appendix A) was developed by the researcher based on extensive literature review on areas related to medical laboratory practice and electronic services. These areas included challenges medical laboratory personnel face in the use of electronic services and devices in the laboratory, impact of electronic services on the attitude of laboratory personnel, some unique skill that must be acquired in using electronic devices in the laboratory and finally measures to be put in place to ensure effective use of electronic services in the laboratory.

A pool of 39 items was created using the content of areas reviewed as a guide. The items consisted of both positive and negative statements to avoid respondents' answers being skewed toward the positive responds options. The questionnaire had open and close ended items.

### Pilot Test

In this study, Electronic Medical Laboratory Personnel Services for Efficient Health Delivery Services in Ghana instrument was piloted with 5 medical laboratory personnel from the Baptist Hospital in Winneba to validate the effectiveness of the instrument, and the value of the questions to elicit the right information to answer the primary research questions. This preceded the main observation to correct any problems with the instrumentation or other elements in the data collection technique.

### Validity of Instrument

Face validity of the questionnaire items for this study was determined by both Lecturers and colleague students to ensure there were no redundant and ambiguous items. All reviewers' comments and suggestions were collected, analysed and considered. The final draft instrument contained four parts. The first part sought information on personnel biological and educational characteristics such as gender and age. The second and third part of the questionnaire sought information on some of the challenges medical laboratory personnel face in the use of electronic devices in the laboratory and the impact of electronic services on the attitude of laboratory personnel. The final part sought to identify some of the unique skill that must be acquired in using electronic devices in the laboratory and to find some of the measures to be put in place to ensure effective use of electronic services and devices in the laboratory.

### Reliability of Instruments

Data from the pilot test was used to determine the reliability of research questionnaire. Item analysis was at the point carried out to identify items whose removal would enhance the internal consistency of the instrument.

### Data Collection Procedure

Ethical approval was obtained from the Kwame Nkrumah University of Science and Technology (KNUST) ethical committee to medical laboratories whose personnel were part of the target population. The structured questionnaire was administered on the medical laboratory personnel at different times when they were

working. The laboratories accessed included Cape Coast Regional and Teaching Hospital, Winneba and Swedru Municipal Hospitals and Kasoa District Hospital. The mission and private laboratories were Apam Catholic Hospital, St. Joos Hospital, MDS Lancet and Sanford Hospital. All the personnel who used electronic services and devices in these laboratories were eligible to participate in the study, but only those who gave their consents constituted the sample. The respondents were briefed on the intended research and their confidentiality assured as their names were not required. The questionnaire was then administered on the personnel from the selected laboratories.

### Data Analysis

Data collected were screened, coded and entered into computer software. The analysis was done using the Statistical Package for Social Sciences (SPSS version 21) for Windows. Using this software, descriptive statistics function was used to determine the mean scores and standard deviations. These responses were converted into percentages for easy understanding and interpretation.

## Results

Parameter	Number	Percentage (%)
Age		
20-30	34	54.8
31-40	21	33.9
41-50	6	9.7
≥50	1	1.6
Sex		
Male	38	61
Female	24	39
Type of hospital		
Teaching	6	9.7
Municipal	14	22.6
District	13	21
CHAG	14	22.6
Private	15	24.2
Staff Grade		
BMS	41	66.2
Technician	13	20.9
Assistant	1	1.6
Others	7	11.3

**Table 1:** General characteristics of study participants.

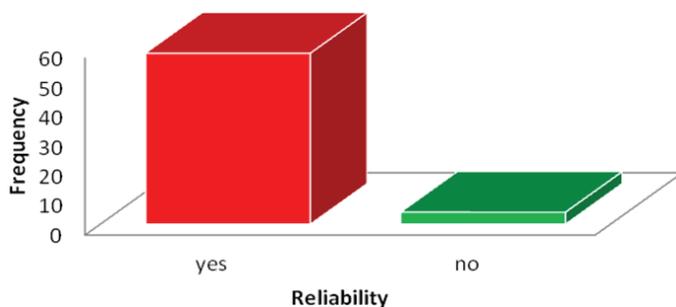
Table 1 shows the general characteristics of study participants. Most of the respondents were males (61%) with 39% females. The dominant age group was 20-30 years (54.8%) followed by age group of 31-40 years (33.9%). Six of the respondents representing 9.7% work in the Teaching hospital, 14(22.6%) work in Municipal hospital with 13 (21%) of respondents working in District hospital. Most (66%) of the respondents were medical laboratory scientist thus degree holders with only one (2%) of the respondents being a laboratory assistant thus certificate holder. Also, 13 (21%) were technicians (diploma holders), and 7 (11%) had other qualifications.

Table 2 shows the mean scores of responses for challenges personnel face. Majority (66.1%) of the respondents showed positive attitude towards the operation of electronic device as less challenging (M=2.6613, SD=0.47713). The table also revealed that 48.4% (30) of the respondents had positive attitude towards understanding principle under which electronic devices work (M=2.4839, SD=0.50382). However, the supply of electronic device accessories such as reagent was observed to be a challenge and only 37.1% (23) of the respondents agreed that it was easy. A little over a quarter 27.4% (17) of the respondents out of the total number of respondents agreed that calibration of electronic device was easy, and therefore revealed negative response. Less than a quarter 14.5% (9) of the respondents out of the total number of respondents agreed that maintenance/servicing of electronic device was easy. This indicate that a significant number of the respondents have challenges in using electronic device when there is the need to either maintain or service them.

With the documentation of result by electronic equipment as a challenge, most of the respondents, 71% (44) of the sample scored 3 with a mean of 2.6452 and standard deviation of 0.6031. This indicates that documentation of results was not a challenge when it comes to the use of electronic device.

Variable	Frequency count	Percentage frequency	Mean	SD
The operation of electronic device			2.6613	0.47713
Difficult	0	0.0		
Moderate	21	33.9		
Easy	41	66.1		
Understanding of operation manual			2.3226	0.69599
Difficult	8	12.9		
Moderate	26	41.9		
Easy	28	45.2		
Supply of electronic device accessory e.g. reagent			1.8548	0.76494
Difficult	9	14.5		
Moderate	30	48.4		
Easy	23	37.1		
Calibration of device			1.8226	0.73605
Difficult	8	12.9		
Moderate	37	59.7		
Easy	17	27.4		
Maintenance/servicing of device			1.9032	0.61962
Difficult	15	24.2		
Moderate	38	61.3		
Easy	9	14.5		
Understanding principle which device work			2.4839	0.50382
Difficult	0	0.0		
Moderate	32	51.6		
Easy	30	48.4		
Documentation of result by device			2.6452	0.60318
Difficult	4	6.5		
Moderate	14	22.6		
Easy	44	71.0		

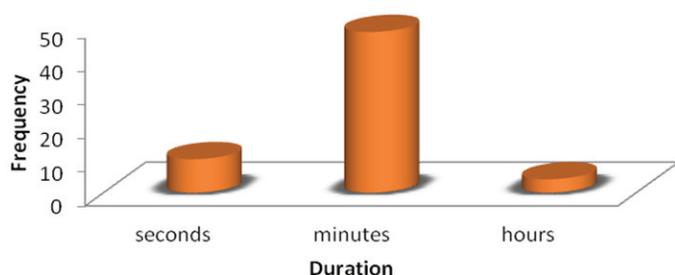
**Table 2:** The respondents' responses on challenges faced by personnel.



**Figure 1:** The respondents' responses on the reliability of electronic service/device.

From Figure 1, almost all the respondents agreed to the fact that results produced by electronic device are reliable as indicated by 93.5% (58) out of the total sample. Only 6.5% (4) of the respondents said results produced by electronic equipment are not reliable.

The average duration most of these electronic devices produce result is in minutes as given by the respondents (77.4%, 48). Again, 6.5% (4) of the respondents however said the equipment produce results in hours. Finally, 16.1% (10) of the respondents said electronic equipment produced results in seconds (Figure 2).



**Figure 2:** The respondents' responses on the duration electronic devices produce.

## Result

Table 3 presents mean score, standard deviation and percent frequencies on the respondents' attitude in the use of electronic services' attitude scale. The mean scores of the respondents range between 3.3871 and 4.7097 while the standard deviations range between 0.45762 and 1.42983. Most of the mean scores items were above 4 (i.e. high agreement of the respondents) such as; "the use of these electronic device is helpful" with a mean score of 4.6774; "I work faster with these electronic device" had a mean score of 4.7097 and "electronic devices are user friendly" had a mean score of 4.3548. Percentages of most of the items were also very high in agreement.

However, in two of the items thus "I have difficulty in working when these electronic device break down" and "I have alternative means of working when these electronic device break down", percentage of the respondents who disagreed were 32.2% and 25.8% respectively. This indicates a number of the respondents were not in agreement to the development of positive attitude towards medical laboratory practice.

## Discussion

This study examined the challenges medical laboratory personnel face in the use of electronic services and devices and its impact on the attitude of medical laboratory personnel.

Majority of the respondents in this study showed positive attitude towards the operation of electronic devices understanding principle under which electronic devices work. However, the supply of electronic device accessories such as reagent was a major challenge. This is in line with the work of Chapman (2005), which reported that the use of modern technology in the laboratory demanded high capital cost in terms of instrument installation and maintenance. According to his study, the status of international market may affect the supply of reagents and spare parts of equipment. Finally, the availability of maintenance of instruments and supply of reagent kits is limited to 'big' cities and not available in remote areas.

Item	Frequencies (%)					Mean (SD)
	SA	A	NS	D	SD	
Use of electronic service/device is helpful	42 (67.7%)	20 (32.3%)	0 (0%)	0 (0%)	0 (0%)	4.67 (0.47)
I enjoy the use of electronic service/device	39 (62.9%)	23 (37.1%)	0 (0%)	0 (0%)	0 (0%)	4.62 (0.49)
I work faster with electronic device	44 (71.0%)	18 (29.0%)	0 (0%)	0 (0%)	0 (0%)	4.71 (0.46)
I have difficulty working when electronic device break down	17 (27.4%)	19 (30.6%)	6 (9.7%)	11 (17.7%)	9 (14.5%)	3.39 (1.43)
I have alternative means of working when electronic device breakdown	11 (17.4%)	31 (50.0%)	4 (6.5%)	10 (16.1%)	6 (9.7%)	3.50 (1.24)
Electronic device are user friendly	30 (48.4%)	25 (40.3%)	6 (9.7%)	1 (1.6%)	0 (0%)	4.35 (0.72)
I encourage other labs to use electronic device	35 (56.5%)	26 (41.9%)	0 (0%)	1 (1.6%)	0 (0%)	4.53 (0.59)
I spend less time conducting test	41 (66.1%)	20 (32.3%)	0 (0%)	1 (1.6%)	0 (0%)	4.63 (0.58)
It is easier to document	31 (50.0%)	31 (50.0%)	0 (0%)	0 (0%)	0 (0%)	4.50 (0.50)

**Table 3:** The respondents' responses on the impact of modern technology.

A little over a quarter (27.4%) of our respondents agreed that calibration of electronic devices was easy, and therefore revealed negative response, with about 15% responding that maintenance/servicing of electronic device was easy. This indicates that a significant number of the respondents have challenges in using electronic device when there is the need to either maintain or service them.

With the documentation of result by electronic equipment as a challenge, most of the respondents scored 3 with a mean of 2.6452 and standard deviation of 0.6031. This indicates that documentation of results was not a challenge when it comes to the use of electronic devices.

It is in this direction that the study sought to identify some of the challenges medical laboratory personnel face in the use of electronic service and device and put in measures to help address these challenges.

A higher proportion of the respondents agreed to the fact that results produced by electronic devices are reliable, with average duration of production being minutes indicating a better turnaround times.

The study also revealed that the use of electronic device in the medical laboratory has had a positive impact on the attitude of some medical laboratory personnel. The mean score for most of the sub-scale was above 4 indicating positive attitudes. The implication is that some medical laboratory personnel have acquired some positive attitudes toward the practice of their profession after the introduction of electronic service and device in medical laboratories. This is not surprising, since most of the laboratories are now moving from the manual way of practicing to the use of electronic services. The above findings are in line with Seaberg et al. (2000), who confirmed technology makes use of laboratory equipment more user friendly, and also give better control of the entire process affecting the attitude of personnel positively. Again, Lam et al. (2012), also reported that other benefits of electronic services in medical laboratories in relation to attitude of personnel include; decrease in the turnaround time (TAT) for the investigations.

According to Markin and Whalen (2000), in order to obtain high throughput, proper documentation, efficacy and accuracy with minimum expenditure of reagents in limited time and space, use of technology in the medical laboratory becomes very important.

However, the use of electronic services and device in the laboratory also had some negative impact on the attitude of personnel. The mean score for two of the sub-scale was below 4 indicating negative attitudes. Chapman (2005) reiterated that in cases of breakdown or if the equipment is out of order, alternative arrangements are very costly and personnel often do not care leaving patients stranded. This was similar to the findings in our study, thus often alternative means of working when modern technology equipment break down are not there.

In summary, the introduction of the electronic services has helped develop positive attitude in some medical laboratory personnel towards the practice of their profession.

## Conclusions

Medical laboratory personnel had challenges with the supply of electronic device accessories such as reagent, calibration and maintenance/servicing of electronic device. This requires immediate attention by authorities and other stake holders including the Ministry of Health and its agencies to address these challenges. Some personnel have developed positive attitude towards their work in the medical laboratory due to the introduction of electronic services and devices with each of the personnel receiving training before the use of electronic devices.

## Recommendations

Based on the findings of the study, the following recommendations are made: Reliable suppliers of electronic medical laboratory device and accessory must be engaged by hospital management such that supply of accessories such as reagent and others could be done quarterly. This must be done in order to avoid shortage in supply since most hospitals have policies which allow procurements to be done quarterly.

Medical laboratory training institutions could collaborate with electronic medical laboratories for their students to have attachment and training on electronic medical laboratory services such that before the students complete school they are adequately prepared for electronic services in the various medical laboratories.

The ministry of health must encourage all medical laboratories in Ghana to use electronic services since its use will have a positive impact on the attitude of personnel towards the practice of their profession.

There must be workshops and refresher courses for medical laboratory personnel on the use of electronic services and devices by the Allied Health Professions Council of Ghana on regular basis so personnel could abreast themselves with current trends in the use of electronic services and devices in medical laboratories.

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