
Incorporating Tele-Health Into Disease Surveillance

Jalal-Eddeen Abubakar Saleh^{1, *}, Nuhu Barau Ningi², Dahiru Baba Bashir¹,
Habu Dahiru¹, Isa Mohammed Bello¹

¹W.H.O. Bauchi Zonal Office, Bauchi, Nigeria

²W.H.O. Adamawa State Office, Adamawa, Nigeria

Email address:

drjalals@yahoo.com (Jalal-Eddeen A. S.)

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Abstract: The increasing challenges in the field of public health is on the increase more than ever before and some of these challenges are not only natural but man-made threats; this calls for a concerted effort to have a perfect global surveillance system in place to ensure timeliness, accuracy, reliability, and completeness of disease tracking and reporting. It suffices to mention that the transformations recorded in the public health discipline vis-à-vis information telecommunication technology has tremendously improved disease surveillance with palpable results in the developed countries. Thus, the emergence of health informatics has significantly speed up detection of disease outbreaks, tracking of communicable and non-communicable diseases alike through the use of advanced software applications, increase investment in bioterrorism, syndromic surveillance and the use of automated surveillance systems to monitor both emerging and re-emerging diseases. However, considering the increasing global threat posed by bioterrorism, emerging and re-emerging diseases, there is need for the developing countries to also embrace the Tele-health system and to put in place a functional modern surveillance system.

Keywords: Surveillance, Tele-Health, Telemedicine, Bio-Terrorism, Epidemiologic Surveillance, Traditional Surveillance, Developing Countries

1. Introduction

In this 21st century of information and telecommunication technology and the availability of various modern applications, disease surveillance has remarkably changed. The changes recorded are as a result of the availability of these applications, which greatly supports disease documentation, reporting and tracking using the electronic systems. Notably among these is the Tele-health, which is a unique system that provides health information and advice to the end-user by means of information technology and telecommunication^{1,2}. The Tele-health system, which remarkably transformed both the curative and preventive aspect of healthcare delivery to the end-users, has not only removed distance between patients and their healthcare givers but also opened up opportunities on syndromic surveillance and other surveillance activities improving public health practice across the globe^{1,2,3,4}.

The need to have a comprehensive and effective surveillance system in place to monitor disease trends and ensure that information delivered are accurate, timely and complete should not be over-emphasized; this is one of the

most important ways of preventing disease outbreaks and protecting the health of the public as a whole. However, undertaking this task is only possible if there is a computerize system in place to effectively track, identify, collect, validate, and analyze data for use by the public and other stakeholders with regard to disease outbreaks^{1,2,3,4}.

2. Evaluating the Surveillance Systems

While implementing public health programs, it is important to prioritize activities that ensures adequate planning, implementation and evaluation of programs considering the fact that the resources are scarce^{4,5}.

As we all know, evaluation is the “systematic collection of information about the activities, characteristics, and outcomes of program, services, policy, or processes, in order to make judgments about the program/process, improve effectiveness, and/or inform decisions about future development”⁶. It is important to underscore that evaluations are of different types: formative evaluation, process

evaluation, outcome evaluation and impact evaluation. Thus, evaluation of programs enables program managers to know the impact of the programs and to identify any un-intended consequences especially in relation to policy change^{4,5,6}.

The objective of evaluating surveillance systems is to promote and strengthen standards on how public health resources are used. Effective evaluation of this system especially when dealing with the interests of multiple constituencies require that the evaluator needs to be flexible, and adhere to timeliness and completeness of the process. The evaluator should use valid and reliable information, pay attention to the diagnostic codes and also give consideration to missing values, system quality such as security and hardware/software stability. Furthermore, the evaluator needs to consider user experience such as time to perform tasks and system benefits and ease of its use that includes accuracy and timeliness of detection outbreak, infections averted and cost-effectiveness^{4,5}. While its vital is to have a defined evaluation plan in place before beginning the process, another important requirement is to have data to assess the performance of the system, and effectiveness of the programs that determines the need for a public health action; importantly this is done through epidemiologic surveillance.

Epidemiologic surveillance is the “ongoing and systematic collection, analysis, and interpretation of health data in the process of describing and monitoring a health event”⁷. The information obtained from the epidemiologic surveillance is what guides policy makers to plan for public health interventions, to implement the work plans, and to evaluate effectiveness of the intervention programs⁷. When evaluating surveillance systems, there is need to assess the functionality of the system and to ensure whether the system is working within the confines of the aims and objectives on which it was developed. Any issues detected should be made clear with recommendations on how to improve quality and efficiency. The process should operate in a manner that avoids bias in the reporting so that the outcome of the evaluation would be valid and reliable^{4,7}.

Additionally, the process of evaluating surveillance systems requires that the background data of the disease outbreak as well as the simulated disease outbreak are authentic^{4,7,8}. Nonetheless, each of these has its own merits and demerits hence the need to consider them when selecting one of these approaches. Furthermore, one of the requirements of public health surveillance is that performance of the surveillance system should be assessed both in terms of detection and alerting so as to validate the final outcome^{4,8}. In line with the standard norms of the evaluation process, there are some performance metrics that needs to be considered; these performance metrics include receiver operating characteristics (ROC), activity monitoring operating characteristics curves (AMOC), time-varying statistics and the summary statistics⁴. While the ROC is employed when assessing sensitivity and specificity of the surveillance system, the AMOC curves assesses its timeliness^{4,8}.

As shown by various literature, there are wide varieties of

surveillance systems commonly in use across the globe; some of these have variations in their methodology or on characteristics of the systems, which explains why what works in one system does not necessarily work in another different system. While evaluation of the surveillance systems clearly requires an approach that is flexible, it is a requirement for the evaluator to remember that not all measures that applies to one surveillance system that is applicable to the other systems. The evaluator should be clear on the fact that the success of surveillance systems greatly relies on the balance between their characteristics; the strength of the evaluation of the system equally depends on the evaluator’s ability to assess the characteristics within the confines of the system’s requirements; this clearly determines the need to improve on certain constructs of the system with regards to sensitivity, specificity, simplicity, and timeliness so as to improve the quality and efficiency^{4,8}.

It is on record that advancement in modern surveillance globally, has resulted in the increase demand for standard techniques to accurately evaluate and ensure quality, efficiency and effectiveness on how these systems operates^{4,7}. Thus, it is important to underscore the importance of evaluating and outlining the benefits and the cost effectiveness of the modern surveillance system as there are skeptics questioning the effectiveness of the system especially the early warnings signs and outbreak detection^{4,7}.

The need to partner and collaborate on sharing surveillance information within and between countries is key to addressing the issues of bioterrorism and other public health threats such as the emerging and re-emerging diseases; embracing this strategy would go along way to give early warning signs to the public health authorities to avert disease outbreaks. Established in 2000, the Global Outbreak Alert and Response Network (GOARN) which aims to enhance communication among international networks has tremendously helped towards collecting and sharing of information that otherwise might have been missed by a country; this system immensely help the W.H.O. technical officer in disease outbreak investigations^{4,9}.

Unlike the developing countries, disease surveillance in the economically advanced countries operates on an automated system; this greatly transform how health information of nations is accessed so that policies could be formulated to protect and promote good health not at an individual level but at a population level. Thus, the automated surveillance system offers valuable and timely information to all reporting sites ranging from hospitals to local, state, and the federal health officials with high sensitivity of detecting diseases and other harmful biological agents in a real-time online fashion enabling prompt public health response¹⁰.

3. Implications of Tele-Health

The Tele-health system forms part of that transformation in which health information and numerous sources of surveillance data becomes available for use by the end-user.

The Tele-health could be regarded as a modern concept in healthcare delivery ranging from syndromic surveillance to providing health information to the end-user as at when due. The Tele-health system, though the services it renders is not confined to clinical services alone, has taken leave from the traditional method of healthcare delivery removing barriers between the patient and his attending physician^{1,2,4}.

The Tele-health is defined as a system that provides the end-user with health advice and information through the use of information technology and telecommunication^{1,2,4}. The Tele-health system has gained popularity, acceptance and wider use in the modern public health systems among both the private and public sectors of most developed countries such as the U.K., Canada, Australia and the U.S.; this has eased up syndromic surveillance activities, and access of health advice and information by the end-user^{11,12,19,20}.

In the U.K., agencies within the health sector such as the National Health Service (NHS) uses the Tele-health system in its routine day to day activities; this has enabled the public health professionals as well as other healthcare agencies to have access to vital information and data from the NHS phone triage system commonly referred to as the NHS Direct¹¹. The NHS Direct phone triage system, which annually handles about 7 million calls, generates surveillance data and helps in the detection of early warning signs on disease outbreaks for use by public health specialists¹¹. In consonant with the standards of the Health Protection Agency, the system aims at early identification of syndromes related to infection or bioterrorism^{1,2,4}.

The NHS Direct phone triage systems, which is available throughout the year, has a digital television channel and a website that provides health information to millions of visitors annually⁴. The system is unique as it uses software that allows clinical decision-support to triage patients especially on issues of referral by a family physician, paramedic dispatches and patient self-care services. The software uses 230 algorithms with inputs related to symptoms and questions from users. Information that goes directly into the system enables the nurse to triage the patient using the algorithm. The decisions to triage patients are made on clinical judgment of the nurses as well as the algorithm and most primary care visits are done one-on-one with the clinician^{1,2,4}.

It is clear that the NHS Direct system, initially designed as a tool to triage patients, can be used as surveillance and epidemiological instruments to ease up how public healthcare service is rendered. The system, which is accessed by about twenty-five percent of the population from different geographical locations, clearly needs to be improved to allow end-users from different social backgrounds to access and use the services irrespective of their income status¹¹.

Although Telemedicine and Tele-health are two different entities, they all operate on a similar electronic platform that aims to improve healthcare delivery across the globe. Additionally, the Tele-health could be regarded as an expansion of Telemedicine as it encompasses preventative, promotive and curative aspects of healthcare delivery^{1,2,3}. The

systems uses medical information exchanged electronically from one geographical end to the other so as to improve patients' health condition. Telemedicine involves the use of videoconferencing for consultations, electronic transfer of images, and monitoring of vital signs of patients among others^{1,2,3}. These two systems exchange information using a platform that is often linked to tertiary health centers.

In spite the large sum of money committed into the system of over \$300 million, when compared with the U.K., the Tele-health in the U.S. is far less organized^{3,11}. The functionality of the telephone triage systems in the U.S. is limited to ordinary national programs such as the poison control hot line. Moreover, the effectiveness of the system in the U.S. is limited by issues that are centered on provider reimbursement, healthcare regulations, reluctance on adoption of the technology by healthcare providers, and data management among others^{3,11}.

It suffices to mention that in the U.S. it is Telemedicine that is receiving increasing attention and not the Tele-health. The Telemedicine system has its program networked with clinics, tertiary healthcare centers and community health centers in the rural and suburban areas and provides its services using robots, polycom devices etc. Thus, the Telemedicine could be considered as a unique system with good prospect in the field of modern healthcare delivery as it offers great opportunities to the sector especially during criticality. However, and as shown in the Table, these unique features are not without some limitations that include accessibility and cost to the end-user, geographical availability of broadband Internet, technology standards, privacy protection, and its inability to conduct syndromic surveillance activities^{3,11,21}.

Table 1. Table showing examples of ICT trends and their application to health²¹

Technology trends	Applications to health	ICT policy issues
Broadband Internet	Distance delivery of health care services: consultations, transmission of prescription and purchase of medicines, using text, still and mobile pictures, and voice	Technology standards Privacy protection Costs Geographical availability of broadband Internet
Digitization	Video and pictures Electronic databases and memory chips as patient record archive	Technology standards Privacy protection Costs Geographical availability of broadband Internet
Wireless communications technologies	Mobile communications: health anywhere from everywhere	Technology standards Privacy protection Costs Geographical availability of broadband Internet

The need to improve on the use of Tele-health would require that everyone have unhindered access to primary healthcare services to address the issue of accessibility and affordability of these services, to strengthen the use of Tele-

health in disease prevention and primary care services, and for governments to partner with agencies and establishments towards effective use of the technology at a population level^{12,13}.

4. Conclusion

In conclusion, there is no doubt that Tele-health has opened up a new concept in healthcare delivery and also creates another window of opportunity for Info-tech industries to further explore the market as there is great prospect with its use in the healthcare industry. In addition to syndromic surveillance, health promotion practice, and reduction in cost of managing disease conditions such as infertility, Tele-health also has removed distance between the patients and their physicians by bringing specialist healthcare services to the door steps of patients¹⁴. Additionally, the Tele-health enables patients to be monitored by healthcare workers after office hours significantly reducing the frequency of hospitalizations and ER visits thus improving on the patient's quality of life¹⁵.

The use of Tele-health is not without some limitations, some of which include barriers for individuals from the low social cadre to access services offered by Tele-health due to cost and access to facilities that offer these services; this opens up discourse on social inequity and health inequality among the populace. Furthermore, there are also some dissenting studies linking the use of Tele-health with increase mortality rates of the elderly patients with chronic ailments¹⁶; this has created some criticisms with regards to U.K. government's decision to continue with the Tele-health project¹⁷.

In the short term, operating Tele-health in the developing countries might not be possible due to factors that include poor human and infrastructural development, lack of political commitment on the part of governments of these countries to initiate and sustain the Tele-health project, increasing corruption, nepotism, lack of stable electricity supply, increasing insecurity, poor telecommunication services by internet service providers to mention but a few¹⁸. In spite these challenges, it is high time for the developing countries to embrace the advancement in health informatics and syndromic surveillance through private public partnership to put a system in place to collaborate and share surveillance information with countries that are on the network to benefit from early warning signs to avert disease outbreaks.

The government of the developing countries should lead by example to have the political will and commitment, increase budgetary allocation to the healthcare sector, show genuine infrastructural reforms in the health sector; this is possible through accountability and good governance. The government should engage experienced public health experts who have the knowledge on modern surveillance and health informatics to operate and monitor the country's public health surveillance systems.

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