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Healthcare Personnel's Preference for Age Ranges to Wear Intelligent Mobile Biomedical Sensor (IMBS) for Blood Pressure Monitoring

Oyeleke O.R.,
Department of Computer Science and Engineering, Ladoke Akintola University of Technology Ogbomoso, Oyo-State, Nigeria.

Emuoyibofarhe, O.J.
Department of Computer Science and Engineering, Ladoke Akintola University of Technology Ogbomoso, Oyo-State, Nigeria.

Alamu F.O
Department of Computer Science and Engineering, Ladoke Akintola University of Technology Ogbomoso, Oyo-State, Nigeria.

ABSTRACT
Intelligent Mobile Biomedical Sensors (IMBS) combined with telemedicine have been introduced to overcome problems associated with distance. In order to get prompt access to medical and accurate health care, persons with chronic diseases (i.e. diabetes, rheumatism, hypertension and heart defects) may be monitored remotely for better treatment and response for changes in the illness development at home.
This paper presents an overview of remote healthcare delivery with its conceptual frameworks, healthcare personnel's level of awareness and age preference for the use of IMBS for blood pressure monitoring.

KEYWORDS*:*
Healthcare personnel, biomedical sensors, IMBS, Blood pressure.

1. INTRODUCTION
Almost 70 percent of those who have high blood pressure do not have it under control, and 30 percent are unaware they have it. High blood pressure is costly; it causes more doctor visits than any other condition. (Legislative policy brief, 2007).
The health care system will face an enormous challenge in the near future due to ageing population, welfare diseases and new technology. So-called welfare diseases are increasing. There is large potential in technologies that can give more cost-efficient services. (Dag *et al*, 2005).
Advanced body-wearable biomedical sensors combined with remote monitoring and telemedicine open up for a whole new range of new health care services. Persons with chronic diseases (i.e. diabetes, rheumatism, heart defects) may be monitored for better treatment and response for changes in the illness development. Automatic diagnosis and medication may result in better quality of life. Today there are large costs associated with hospitalization. Biomedical sensors combined with telemedicine will be a cost efficient way of providing health services. (Dag *et al*, 2005).
Biomedical sensors measuring vital data may improve the quality of treatment by enabling health care personnel to respond quickly and more accurate to a given injury or illness and critical changes thereof. Possible scenarios may span an acute illness at home to large accidents or terror acts with lots of injured people. With the latter, biomedical sensor information can be crucial to improve survival rate, e.g. to ensure that critical changes in a patients status is detected. (Dag *et al*, 2005).
The new generation of biomedical sensors and actuators demonstrates unlimited virtual capabilities in measuring, processing, communicating and acting in an intelligent way. New measurements and new approaches are possible including diagnosis, ambulatory healthcare, care at home and at the point of need. (Andreas and Silas, 2003).

2. DEFINITION OF TERMS
A.) **Sensor:** is a device that provides information about the physical, chemical or biological state of a system. This can be key physical parameters like temperature, pressure, velocity or acceleration. It can also be the concentration of a particular substance in e.g. a blood vessel or cardiac nerve potentials. (Dag *et al*, 2005). Sensors convert signals of one type of quantity such as hydrostatic fluid pressure into an equivalent signal of another type of quantity, for example, an electrical signal. (Neuman *et al*, 2000).
B.) Biomedical Sensor: is a device which consist of a biologically or biophysically-derived sensing element integrated with a physical transducer that transforms a measurand into an output signal. (Gerard, 2003).
C.) Intelligent Sensor System: is a system which takes some predefined action when it senses the appropriate input (light, heat, sound, motion, touch, etc). it is basically characterized by the following attributes:
(i) Compensation (Self-diagnostics, self-calibration, adaptation)
(ii) Computation (Signal conditioning, data reduction, detection of trigger events)
(iii) Communications (Network protocol standardization)
(iv) Integration (Coupling of sensing and computation at the chip level). (Ricardo, 2001).

3. BLOOD PRESSURE (BP)
The force or pressure which the blood exerts on the walls of the blood vessels, it could otherwise be referred to as the systemic arterial blood pressure, simply arterial blood pressure, is the result of the discharge of blood from the left ventricle into the already full aorta.
When the left ventricle contracts and pushes blood into the aorta the pressure produced within the arterial system is called the *systolic blood pressure*. In adults it is about 120mmHg (millimetres of mercury). (Anne and Allison, 2002).
When complete *cardiac diastole* (relaxation of the atria and ventricles) occurs and the heart is resting following the ejection of blood, the pressure within the arteries is called *diastolic blood pressure.* In an adult this is about 80mmHg. The difference between systolic and diastolic blood pressures is the pulse pressure. These figures vary according to the time

of the day, the posture, gender and age of the individual. During bedrest at night the blood pressure tends to be lower. It increases with age and is usually higher in women than in men. (Anne and Allison, 2002).

Arterial blood pressure is measured with a sphygmomanometer and is usually expressed as shown:

BP = 120/80 mmHg

Arterial blood pressure maintains the essential flow of substances into and out of the organs of the body. Control of blood pressure especially to the vital organs is essential to maintain *homeostasis* (The composition of the internal environment is maintained within narrow limits, which is fairly constant state). (Anne and Allison, 2002).

4 DISORDERS

Disorders set in when there is a deviation (either an increase or decrease) in normal values of activities of the respective organs in the body. The two commonly known disorders are :

- Hypertension
- Hypotension

4.1 Hypertension

Hypertension is a chronic medical condition in which the blood pressure rises above the normal medical range. It is also referred to as high blood pressure (Goldstein et-al, 2011). It is also defined as blood pressure of 140/90 mmHg based on at least two readings on separate occasions in an adult. Hypertension can be classified as either essential (primary) or secondary. Essential or primary hypertension means that no medical cause can be found to explain the raised blood pressure and represents about 90-95 per cent of hypertension cases. Secondary hypertension indicates that the high blood pressure is a result of another condition, such as kidney disease.

4.1.1 What Causes Hypertension?

In 90-95 per cent of cases, no cause can be found and this is termed essential hypertension. In 5-10 per cent, a cause can be found and this is termed secondary hypertension. Hypertension is a disorder to which both environmental and genetic factors contribute (Victor, 2011).

4.1.2 Who Is At Risk Of Developing Hypertension?

Risk factors for essential hypertension include age greater than 40 years, male sex, family history of hypertension, high salt diet –in predisposed individuals, overweight/obesity, physical inactivity, excessive alcohol consumption, inadequate intake of vegetables and fruits, diets high in 'sleepy' fats. Primary prevention of hypertension can be done by reducing or modifying the risk factors already present in the individual and the community, to forestall the development of overt disease.

4.1.3 Risk Factor of High Blood Pressure

High blood pressure is prevalent if one is

African American
Obese
Often stressed or anxious
Drink too much alcohol (more than one drink per day for women and more than two drinks per day for men)
Eat too much salt in your diet
Have a family history of high blood pressure
Have diabetes
Smoke

4.2 HYPOTENSION

Hypotension is abnormally low blood pressure, especially in the arteries of the systemic circulation (Mayo Foundation for Medical Education and Research, 2009). It is often associated with shock.. Hypotension is generally considered as systolic blood pressure less than 90 millimeters of mercury (mm Hg) or diastolic less than 60 mm Hg. (Mayo Foundation for Medical Education and Research, 2009). However in practice, blood pressure is considered too low only if noticeable symptoms are present

4.2.1 Causes

Low blood pressure causes can be due to low blood volume, hormonal changes, widening of blood vessels, medicine side effects, anemia, and heart and endocrine problems.

Decreased cardiac output despite normal blood volume, due to severe congestive heart failure, large myocardial infarction, heart valve problems, heart attack, heart failure, or extremely low heart rate (National Health Service (NHS).)

This usually occurs as a complication of other conditions, like shock, sepsis and haemorrhage. Low blood pressure leads to inadequate blood supply to the brain. Depending on the cause, unconsciousness may be brief (fainting) or more prolonged, possibly causing death. Postural hypotension syncope (fainting) is due to sudden reduction in blood pressure on standing up quickly from a sitting or lying position. It occurs most often in the elderly. (Anne and Allison, 2002).

5 REMOTE HEALTH CARE MONITORING

Remote Health Care Monitoring System focuses on the development of Healthcare Service Computer based System. It also includes other Health Information Technology systems which keep track of medical information, such as the practice management system which supports the electronic medical record. Patient suffering from hypertension is attended to and monitored from thousands of miles away. The Patient health is being monitored by a healthcare practitioner through the use of Health Care monitoring System.

Constant monitoring of a medical situation allows complications to be detected sooner, thus providing opportunities for earlier intervention to manage the condition. Rigorous system based management of chronic conditions is essential to improve healthcare outcomes. Remote health care monitoring system is used in acquiring vital information about a patient who lives far away from medical support and it can alert medical staff if there is a dangerous change in patient's status, the use of computer to solve problems that previously could be solved only by applying human intelligence. With e-care system, doctors spend less time going to see patients and more time treating them. It also means real time monitoring without high staff or capital costs. Remote patients monitoring collects disease specific metrics from biomedical devices used by the patients in their homes or other settings outside of a clinical facility. The use of computer system was develop for a whole range of applications, including for medical diagnosis

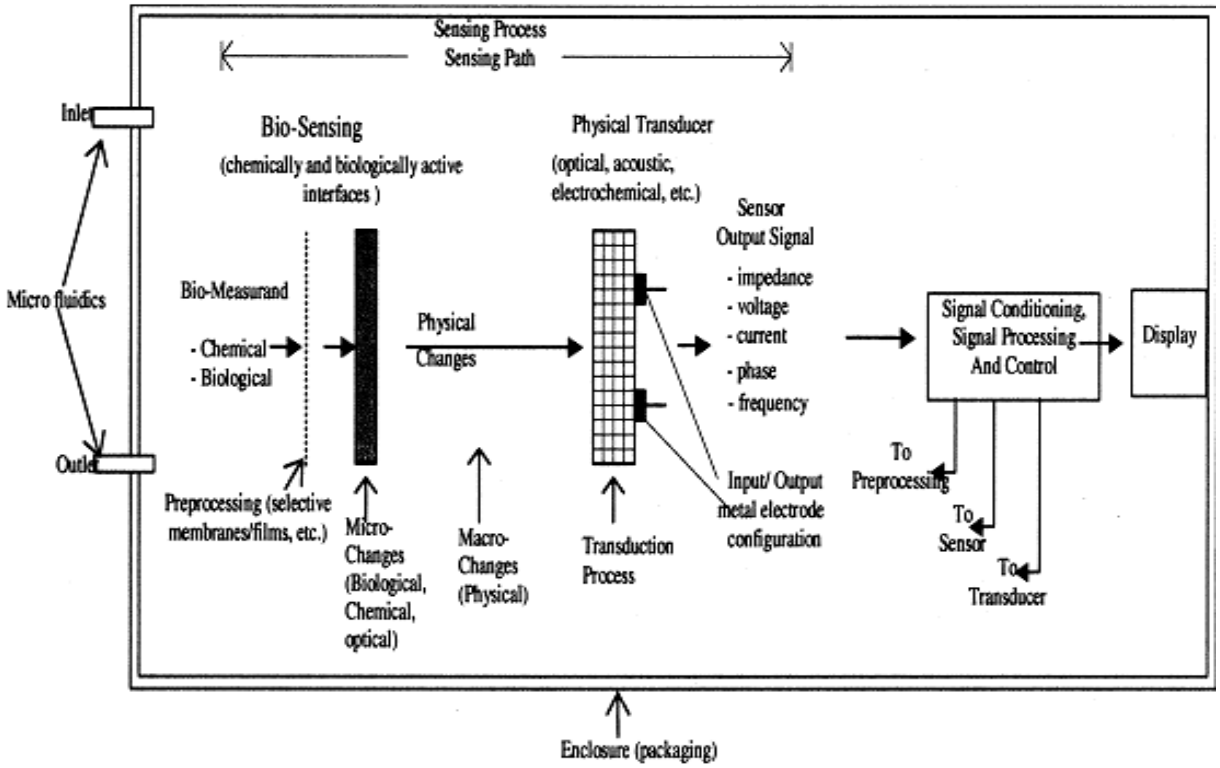

Figure 1: General Diagram of a Biomedical Sensor System. (Gerard, 2003).

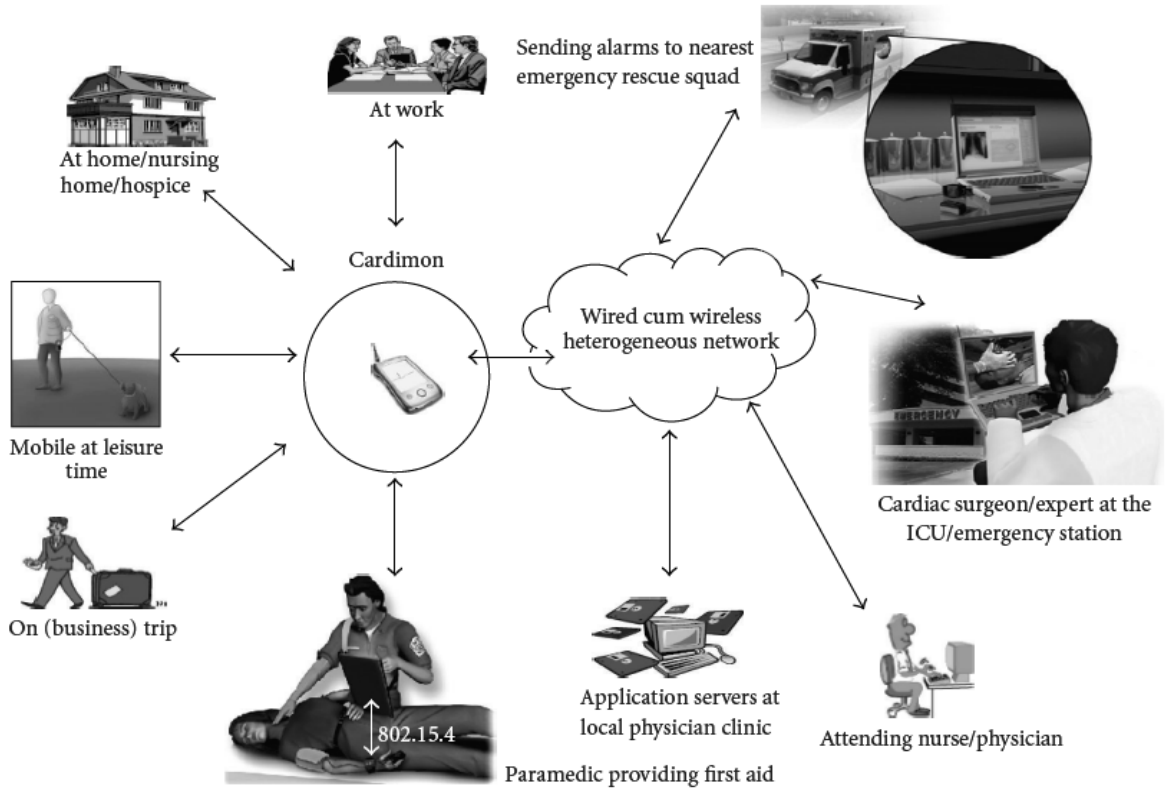

Figure 2: Conceptual Framework for Patient Monitoring Using Intelligent Mobile

Biomedical Sensors. (Sunil *et al*, 2008).

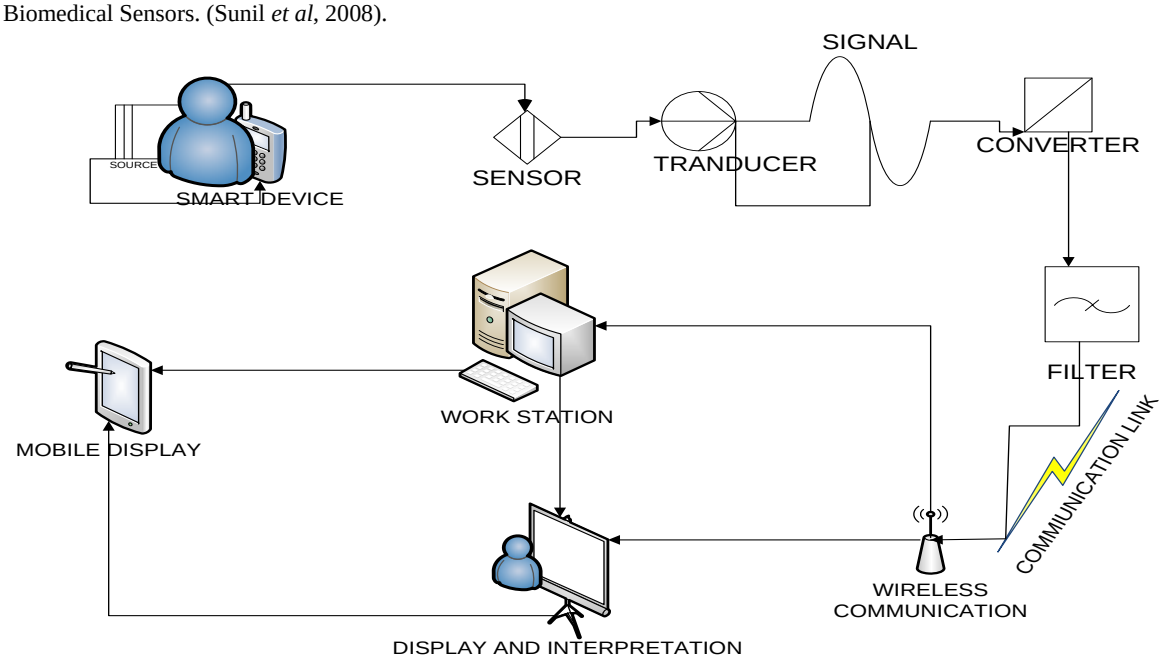

Figure 3. Physical flow

5. SURVEY

5.1 Population, Sample and Sampling Technique

Populace who are health care personnel, working in the chosen health institutions in Nigeria, were considered. These health institutions are; Ladoke Akintola University of Technology Health Centre, General Hospital, Shalom Medical Centre, Jubilee Medical Centre, Ireti-Olu Hospital and Bowen University Teaching Hospital. Fifty (50) health care personnel were selected randomly to represent a typical viewpoint of health workers working in these health institutions. Only Medical Practitioners and Nurses were given questionnaires to be filled since both professions have been known to have a close contact with the patients.

5.2 Administration of Instrument

Copies of the questionnaire were randomly distributed among the health care personnel in the health institutions mentioned earlier. It was distributed through personnel visit to the health institutions and through the help of some nurses in the various health institutions. The health care personnel were instructed to tick and supply answers to the questions correctly. More so their identities were not disclosed. The questionnaires were collected through the same procedure used in distribution.

5.3 Instrument for Data Collection

The instrument used for Data Collection was a self-designed questionnaire moderated by health care personnel. This was used with the belief that it would serve best in gathering necessary data and for easy analysis of their responses. Fifty (50) copies of questionnaire were used to sample the opinions of the health care personnel.

5.4 Procedure for Data Analysis

The data were gathered through the responses of the respondents from questionnaire on Healthcare personnel's preferences for age ranges to wear IMBS. Forty (40) questionnaires were analyzed by calculating the frequency of each item on the questionnaire and based it on the number of the usable copies of the questionnaires, and simple percentage count was used to calculate the data and results are as shown below:

6. RESULTS

A total of fifty (50) questionnaires were distributed among six different hospitals (both public and private) in Nigeria. A total of forty (40) out of the 50 questionnaires sent out were received with responses, while ten (10) were returned blank. The respondents were mainly medical doctors and nurses. The findings are analysed as follows:

Table 1: Respondents who recognise existing Intelligent Mobile Biomedical Sensors.

Do you Recognise existing Mobile Biomedical Sensor?	Frequency	Percentage %
Yes	23	57.5
No	17	42.5
Total	40	100

From Table 1, it was revealed that Twenty-three (23) out of 40 respondents represents those who recognised existing intelligent mobile biomedical sensor while 17 out of the 40 respondents represent those who do not recognise existing IMBS. The frequency shows that 57.5 percent represents respondents who recognised existing IMBS while 42.5 percent represent respondents who do not recognise existing IMBS. Hence, those who recognise existing IMBS had the highest frequency.

Table 2: Healthcare personnel's preference for the age ranges that should wear IMBS.

Age ranges (years)	Frequency	Percentage %
18-25	4	12.1
26-35	6	18.2
36-55	13	39.4
56 and above	10	30.3
Total	33	100

From Table 2, it was observed that 4 out of 33 respondents were of the opinion that people whose ages fall within the ranges of 18-25 years should wear mobile biomedical sensor and 6 out of 33 respondents were of the opinion that people who fall within the age bracket of 26-35 should wear mobile biomedical sensor while 13 out of 33 respondents indicated that mobile biomedical sensor should be worn by people whose ages fall within ranges of 36-55 years and 10 out of 33 respondents chose people from the ages of 56 years and above to wear mobile biomedical sensor. The frequency of the respondents shows that the age range 18-25years represents 12.1 percent and also age range 26-35 represents 18.2 percent while age range 36-55 represents 39.4 percent and age 56 and above represents 30.3 percent. However, 7 out of the 33 respondents had a different opinion from other respondents as regards the age ranges that should wear mobile biomedical sensor. They were of the opinion that age should not be used as a yardstick for wearing biomedical sensor and would suggest that is should be worn by everybody irrespective of their ages.

7. CONCLUSION

As age is a core to influencing the blood pressure level of an individual as one keeps growing, it is important to know the risk associated with each age brackets. From Table 2 above, it appears that the age bracket of 36-55 has the highest number of frequency and percentage respectively hence, people within this age range are preferred to wear IMBS. However, hypertension resulting from other diseases accounts for 10 to 15% of all cases, and as some health care personnel have suggested that IMBS should be worn by everybody, it is worth considering.

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