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Can an automated vitals kiosk machine deliver quality vital measurement?

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ABSTRACT

Vital signs monitoring is an important first step in the early detection of the clinical conditions of patients in a hospital OPD setting. In all hospitals, the vital measurements are recorded by trained staff nurses in OPD before a doctor consult. A Nurse is a very valuable and scarce resource in a hospital setting and repetitive mechanical tasks like measuring vitals need not be done by a nurse in an OPD and can be automated using a kiosk so that nurses can be redeployed for clinical care. India Health Link (IHL) self-service kiosks can measure parameters like Blood Pressure (BP), Body Mass Composition (BMC), Height, Weight, Body Mass Index (BMI), Electrocardiogram (ECG), Pulse rate, Oxygen saturation (O2), Body Temperature and a 6 lead ECG – All basic parameters which are required pre doctor consult. If placed and used in a hospital setup, it could potentially reduce the time to doctor for all patients, since they need not wait for vitals reading by a dedicated medical professional. It could also help prioritize which patients may require the immediate attention of the doctor and whether the patient is to be treated in an emergency or can be redirected to OPD. It could also be advantageous if installed in public hospitals making it accessible to a large number of people, thus reducing the time to doctor by highlighting any abnormalities in vitals readings – and making the user aware of the same.

Keywords: *Healthcare, Automated Vitals Measurement, Technology, Kiosk, Quality*

1. METHODOLOGY

In this compartiative study, an ATM sized IHL health kiosk was utilized and a data sample of the vitals reading (Weight, Body Mass Index, Body Mass Composition, Pulse Rate, Blood Pressure, Body Temperature, Oxygen Saturation for patients visiting OPD of Dr Mehta's multispeciality hospital,Chetpet,Chennai was collected and compared with readings from trained medical professionals and the accuracy and variance of the health kiosk readings was assessed.

The Vitals reading by the kiosk tool approximately 5 minutes for each patient .The patients were randomly assigned for vitals checking manually first followed by the kiosk measurement in the same setting one after the other, with no more than 5 minutes gap between both measurements. An Ethical committee approval from institutional ethical committee was obtained for the study

2. ANALYSIS OF DATA

A total of 1139 patients participated in the study, between the ages of 18 and 83 years. The Samples are almost evenly distributed between male (around 52.9%; 603 samples) and female (around 47.1%; 563) patients

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3. RESULTS AND ANALYSIS OF DATA

Below table represents the mean score difference between manual measurements and the kiosk measurements.

	Group	N	Mean	Std. Deviation	Mean Diff.	P-value
Systolic Blood Pressure	Manual	1135	120.48	19.056	-1.235	0.138 (NS)
	Kiosk	1135	121.71	20.334		
Diastolic Blood Pressure	Manual	1135	76.27	11.387	-1.201	0.017 (Sign.)
	Kiosk	1135	77.47	12.429		
Weight	Manual	1131	72.09	13.305	-0.223	0.692 (NS)
	Kiosk	1131	72.31	13.25		
Temperature	Manual	792	97.17	1.804	0.219	0.015 (Sign.)
	Kiosk	792	96.95	1.771		
Pulse Rate	Manual	1030	84.72	11	0.052	0.917 (NS)
	Kiosk	1030	84.67	11.911		
SPO2	Manual	853	98.32	0.93	0.072	0.552 (NS)
	Kiosk	853	98.25	3.364		

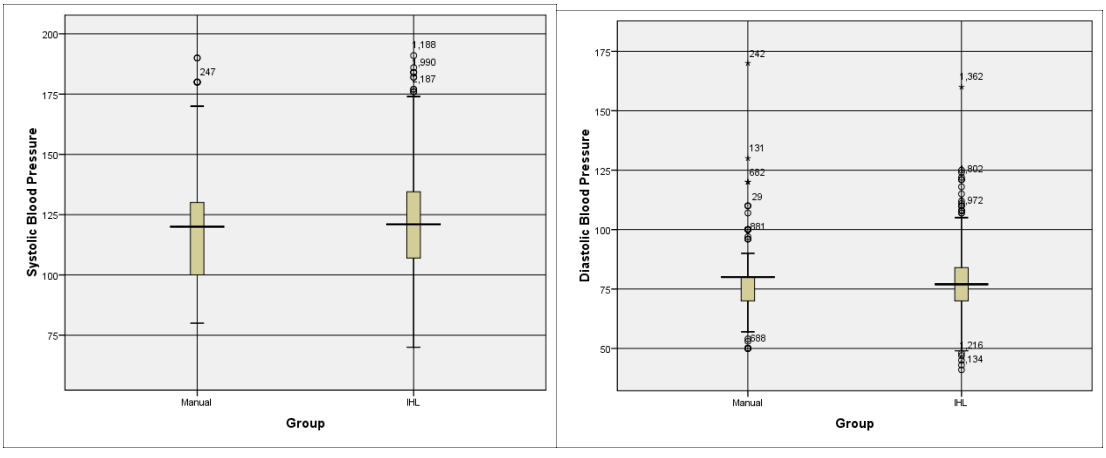
**NS: Not Significant, Sig.: Significant difference between the mean score at 5% level of significance.*

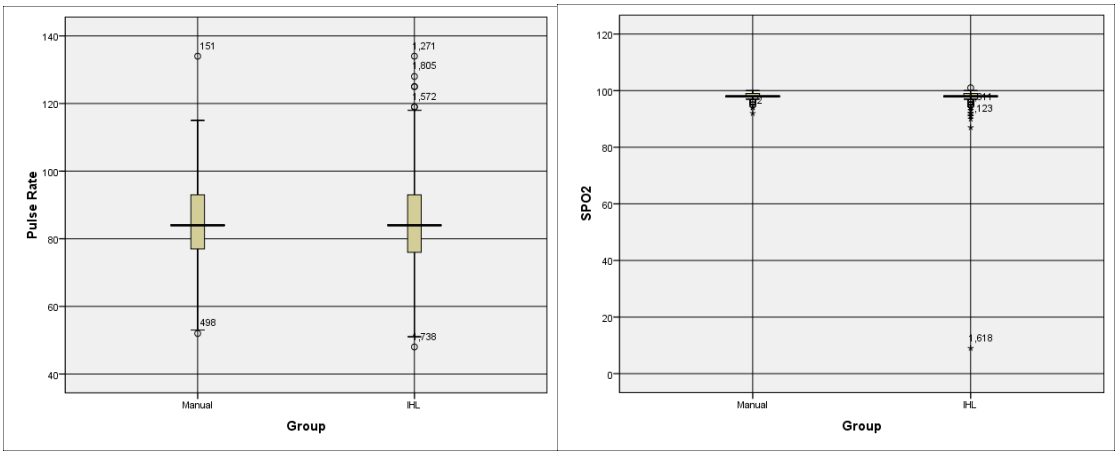
The below figures contain the box plot for all the study parameters which shows the mean score for manual measurements vs kiosk measurements , mentioned with the bold line and the range of box represents the 95% confidence interval and balloon and star mark in the figure represents the extreme measures of observations.

If we observe the figures, wherever the extreme observation are found in manual measurements correspondingly kiosk also shown the same measurements it means that, the agreement between the measurements are almost same.

Hence it can be assumed that that manual measurements can be replaced by the kiosk instrument measurements reliably and also A total of 92.4% of the custyomers gave a feedback of Easy to Very Easy to use.

Figure –





4. LITERATURE REVIEW

This section discusses the recent works of Electronic Health Records (EHR) and automated health care monitoring and management in recent years.

Varma[1] designed a microcontroller-based Body Mass Index (BMI) calculator, which calculates the BMI of a person with the help of two parameters i.e. height and weight. The hardware consists of a weighing machine, which measures the weight of the person in terms of kilograms and a height sensing device which calculates the height using a Light Dependent Resistor (LDR), with the available data BMI of the person is calculated, displayed in the LCD display and sent to the personal mobile number using GSM module. The limitation is that the final reports to be prepared manually, there are no minimum fat burning records and there is no cloud storage to maintain records for the future.

A semi-automatic digital blood pressure monitor was proposed in[2] , which measures both the systolic and diastolic pressure of a person. A piezoresistive silicon pressure sensor is used as the transducer to measure the pressure with a range of 0-7.3 PSI. Measuring health pressure regularly helps to distinguish patients between genuine high blood pressure and hypertension. The proposed method is not portable for gym goers who increase their blood pressure often and there is no cloud storage to maintain the patients' records.

Joshi[3] analyzed cardiac disease using Electrocardiogram (ECG) signals for Cardiac Arrhythmia using the analysis or abnormal and normal wave patterns, the work also classified the heartbeats according to different arrhythmia. The limitation is that it cannot able to provide instant measures with high accuracy in less time.

Thanapatay[4] proposed ECG beat classification for ECG printouts using Support Vector Machine and Principle Component Analysis. In order to extract the shape, discrete wavelet transform filters were applied to remove noise from the ECG signal, later it is processed using image processing technique.

Tang[5] proposed an unobtrusive cuffless blood pressure monitor using the pulse arrival time. ECG and PPG were used to calculate the pulse arrival time of the patient; the proposed system was the potential to calculate long term blood pressure of the patient.

Zheng[6] proposed a new blood oxygen monitoring based on the combination of general oxygen monitoring with attribute theory; the system uses 2ml of blood and detects the oxygen levels in the blood with attribute theory, the system lacks in detecting the purity of blood, functions of heart and cloud storage for future analysis.

An automatic medicine dispensing machine was proposed in[7] , the system consists of a microcontroller and a motor, that dispenses the medicine, based on the input such as body temperature and blood pressure.

Veeraraghavan[8] developed a PC logging tool that extracts the insights from the accessed information in the system, the tool successfully extracted the information from the patients in several areas of Maharashtra and Uttar Pradesh, the system was found to an effective one than the kiosk operator which involves in a questionnaire method for gathering information.

Navdeep[9] reviewed the existing cloud storage technologies, its security concerns, and challenges in its maintenance and operation. Privacy-preserving synthetic logarithmic perturbation technique for incremental data in the cloud environment was proposed in[10] , where the data is stored in the cloud is subjected to a synthetic logarithmic perturbation before storing the data in the cloud, the proposed system outperforms the traditional masking approaches. Machine learning classifiers[11,12,13,14] can also be used in the diagnosis of health-related issues.

5. CONCLUSION

The objective of this study was to assess the quality of vitals data from a health kiosk in a hospital OPD setting.

In general, the readings gathered from the kiosk followed the same general trend as manual readings. Depending on the parameter in question, the percentage of data mismatch (High BP, High Temp, High Pulse Rate etc,) are less than 2% and this is marginal.

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Such patients could be triaged by medical professionals as a second level of screening. What can be seen here is that, the number of false negatives (if the kiosk reads the BP of a confirmed high BP patient as normal/acceptable) is lesser than the number of false positives (less than 1%) for all parameters.

In addition, the kiosk was also reasonably easy to use as seen by 92.4% of the patients used gave a feedback of " Easy to Very Easy to use" using a Likert scale measurement for feedback.

Hence it can be concluded that the kiosk can be a reliable adjunct to vital measurement and triaging patients in the OPD setting of the hospital and also has potential use in community setting like airports,malls etc as a community screening tool.

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