Development of an Ambulatory Vital Sign Monitoring Device Using IOT: A Review

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ABSTRACT: *Everything in life today is advancing with the internet, and healthcare is not left behind. The latest advancement in internet is the Internet of Things (IoT), and most health researchers would say it is found most valuable in the healthcare industry. This work aims to review the internet of things to the ambulatory aspect of the healthcare industry for the continuous monitoring and onward transmission of physiological parameters of the heart rate, and temperature of ambulatory patients, and sending the values through a Wi-Fi module, to the cloud based server, where it is stored and can be accessed anytime by the physician and patients, by logging in their details to the online application. This does not only give the real time monitoring, but also the patient history, and it helps to save the time spent in the hospital, and the cumbersome tasks of a health practitioner performing the tests manually on the patients when they come to the hospital for checks.*

KEYWORDS: Pulse sensor, ESP module, stretch sensor, Internet of things.

INTRODUCTION

The Royal College of Physicians – Acute Medicine Task Force defines ambulatory care as a clinical care which may include diagnosis, observation, treatment, and rehabilitation, not provided within the traditional bed base or within the traditional out-patient services that can be provided across the primary/secondary care interface (National Health Service [NHS], 2012). Ambulatory care is same day services with extensions that involves a clinic visit, medical office visit, and outpatient treatment. Ambulatory services may be urgent, routine, or emergent situations scheduled based on indications to visit such as sports physical examinations, immunizations, blood tests, scans, endoscopies and biopsies (Roderick, 2008).

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Ambulatory care takes place in several settings such as, hospital based ambulatory care center, fee-for-service medical practice, community health centers, school and university health centers, ambulatory surgical centers, family planning clinics, mental health centers, urgency care centers and with the most important ambulatory care site being the medical practitioner's office (Roderick, 2008). The applications of ambulatory care can be found in several areas of health care. For example, an ambulatory electrocardiography (AECG) monitor, is a device used for continuous monitoring of the electrical activity of a patient's heart muscle for 24 hours or longer, the AECG can be used on patients with symptoms related to cardiac arrhythmias (e.g., palpitation, syncope), and also for assessing anti-arrhythmic drug response and pacemaker and implanted cardioverter/defibrillator function. Furthermore, the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure recommends that ambulatory blood pressure monitor be used in patients with suspected white coat hypertension, those with apparent drug resistance, and those exhibiting hypotensive symptoms while taking antihypertensive medications, those with episodic hypertension, and those with autonomic dysfunction. Also, ambulatory heart rate monitoring may be used as part of a program to improve cardiovascular fitness, to identify a physiological marker to stress reactivity, and to monitor changes in heart rate related to any cardiovascular disease or condition. Additionally, skin temperature monitoring can be used for training people to promote vasodilation or peripheral blood flow, and can also be used to assess vascular responses to stress. Ultimately, the ambulatory activity monitor has applications in many fields of science and medicine for assessment of pathological states with movement-related components, including sleep quality and patterns, geriatric inactivity, hyperactivity (e.g., attention deficit hyperactivity disorder), neurological conditions, and cancer-related fatigue or chronic fatigue syndrome, also useful in monitoring and assessing effects of drugs on the central nervous system, it also finds use in biological and behavioral studies related to activity and chronobiology (Pei-Shan, Kristine & Carolyn, 2003). Studies have shown in the United States designed outpatient services that have cared for an estimated 1.2 billion visits to physician offices, clinics, and emergency rooms in 2005, giving a rate of four visits per person annually (Burt, McCaig & Rechtsteiner, 2007). This increase in ambulatory care is due to its benefits and some of them, includes Screening for admission to hospital, Follow-up care and care after discharge, Early diagnosis, preventive, curative and rehabilitative care on ambulatory basis, effective treatment, and it is less capital intensive for both practitioners and patients, with the base construction cost for an ambulatory care facility is about $190 per square foot, depending on location versus about $320 per square foot for a hospital. (Tabish, 2016). As with everything that has an advantage, there is also a disadvantage, therefore everal challenges face ambulatory care everywhere, and in Nigeria (though there are no records for this), some of these challenges includes issues of patient identification, failure to diagnose properly, inadequate screening and follow-up, over-sedation problems, communication problems due to far and in between visits. (Hammons, Piland, Small, Hatlie & Burstin, 2003). Some of these challenges, especially those caused by human factors can be prevented by monitoring and acting on symptoms. (Gandhi, et al, 2003).

The Internet of Things is an aspect of future internet, that is essentially used to settle the issue of interconnection for example, things to things, human to things and human to human, things in the

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physical world can be stepped up, with regards to trading data, by means of the internet, to achieve interconnection to each other. In the internet of things (physical and virtual) have attributes and virtual personalities, that utilizes smart interfaces, seamlessly arranged, and relied upon to end up as important components in data, social and business undertakings, where the "things" are equipped to interact among themselves and with nature, and designed in a self-controlling way to the physical things, and imparting it by running procedures that trigger a series of activities, and make decisions without direct human intervention. (Kumar et-al, 2017).

IoT can be actualized through Barcode, Zigbee, Wi-Fi, radio frequency identification technology (RFID), sensors and smart phones, this future internet can find its use in various fields like in aviation for activity checking, transport co-ordinations, security. Social insurance, for social insurance checking arrangement of the patients (purnima, 2014).

MATERIALS AND METHODS

The materials and method that would be use in doing the work were listed and explain below:

Materials Needed

The materials to be used for the construction are:

- Arduino Mega/mini 2560
- Atemega microcontroller
- A suitable length of Velcro
- A laptop downloaded with Arduino
- Jumper wires
- Soldering Wires
- Soldering tools
- Temperature sensor
- Heart rate sensor
- ESP module 8266
- Spo_2 sensor
- Respiration sensor

Method

This involves the use of computer to test the circuit after mounting on breadboard before transferring to Vero board. System is divided into hardware and software section. Software is responsible for better working of the system, also for interfacing. Both sections work in parallel process. Hardware is again classified into transmitter section and receiver section. Implementation of transmitter is important part, because transmitter section is directly attached to the patient or human body. PIC is a master device in proposed system; all the other devices like different sensors are connected to it. A DC power supply of 5V is provided for working of ESP8266. IoT server is

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attached to the system; it allows the connectivity for data exchange with other devices. IoT allows connected objects to identify and control remote access across network. The output of temperature sensor and heartbeat sensor is displayed on LCD at user end too. The output also sent to the receiver or doctor end. All the information is first acquired, processed and stored at memory of ESP8266. The stored information is then transferred to the receiver by means of IoT server.

Design Tools

- Digital Multi meter
- Screw drivers
- Epoxy gum
- Perspex cutter
- Hand drilling machine

LITERATURE REVIEW

This review searched the literature for studies that explicitly tried to determine and quantify the increase or decrease in risk associated with changes of intermittently measured vital signs. I therefore, confined my search only to those papers that measured vital signs intermittently and those that used continuous monitoring and novel wearable technology.

Most patients will have had their vital signs measured by a nurse or health care assistant before a doctor sees them. Vital signs are termed 'vital' as they influence clinical-decision making, but such monitoring is expensive and even inaccurate at times (Mariani P et al, 2006). The initial assessment of vital signs frequently dictates the hospitalization decision (Fine et al, 1997a). Similarly, resolution of vital sign abnormalities is an important determinant of discharge decision (Fine et al, 1997b).

It has been suggested that, in relation to vital signs collection, there "is little empirical evidence for existing regimes and, whenever regimens are recommended in the literature, the suggestions appear to be based on current clinical practice" (Botti et-al,2001) Vital signs are collected based on traditional - some would say almost ritual patterns - rather than on evidence-based nursing practice. They are collected routinely and are not determined by the clinician or the individual patient. One survey of nurses demonstrated that vital signs were undertaken as a routine procedure, irrespective of patients' needs (Zeitz & McCutcheon, 2006) There is only limited information regarding the frequency with which vital signs should be monitored and much of this is based on surveys, clinical practice reports and expert opinion (Lockwood et-al, 2004). This review will seek to find evidence supporting an optimal frequency of vital sign measurements and also to determine if the frequent collection of regulated routine vital signs has a positive impact on patient outcomes.

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The issue of accuracy of measurement will be considered in the light of advanced medical technologies being developed for the purpose of determining vital signs. For example, although vital sign measurement is quicker using automated techniques, the accuracy of these measurements in many cases is unknown. A study found in the original systematic review compared vital sign measurements by conventional methods versus automated measurements and found that the latter saved 20 seconds per person, which according to the researchers represented a significant saving when viewed in terms of all hospital patients over a 1-year period (Byers et-al, 1990). However, the study did not provide accurate data on the accuracy of vital signs taken using machines and monitors. Additionally, currently used automated blood pressure measurement devices seem to be less accurate at increasing blood pressure levels (Braam & Thein 1990).

Gope et al, (2015). Explained in the paper "BSN-Care: A Secure internet –based Modern Healthcare System Using Body Sensor Network" about the Body Sensor Network advancements as one of the center advances of internet improvements in medicinal services framework. In this framework a patient can be observed utilizing a gathering of modest fueled and lightweight wireless sensor nodes.

Tzonelih et al, (2015) examined about circulated internet framework engineering and unknown authentication scheme in the paper "Untraceable Sensor Movement in Distributed internet Infrastructure". The proposed framework works in three stages: Registration phase, inter-cluster movement phase and inter-network movement phase. It gives greater security includes the confirmation of less computational overhead.

Kim et al, (2015) proposed a multi-jump WBAN development conspires that is comprises of 4 operations, the grouped topology setup, versatility support, and transmission proficiency improvement. As an assistant advantage, the proposed plot accomplishes a vitality productive component by lessening the quantity of aggregate control messages.

Charalampos et al (2010). Presented platform based on Cloud Computing for administration of portable and wearable human services sensors, showing along these lines the IoT worldview connected on inescapable social insurance.

Gong et al (2014). Analyzed the problems in current smart health care system in the paper "A medical Health care system for privacy protection based on IoT". A lightweight private homomorphism calculation and an encryption calculation enhanced from DES are intended for security assurance.

Lin Yang et al (2014a). Proposed a paper "A Home Mobile Healthcare System for Wheelchair Users" which clarifies the framework engineering and plan of Wireless Body Sensor Networks. The framework is checking the status of wheelchair and living condition to understand the hazardous condition of wheelchair clients.

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Yang et al (2014b). Proposed an intelligent home-based platform, the iHome Health-IoT. The stage includes an open-stage based savvy solution box (iMedBox) with improved network and between variability for the incorporation of gadgets and administrations; shrewd pharmaceutical bundling (iMedPack) with correspondence ability empowered by inactive radio-recurrence distinguishing proof (RFID) and incitation capacity empowered by useful materials; and an adaptable and wearable biomedical sensor gadget (BioPatch) empowered by the best in class inkjet printing innovation and framework on-chip. The proposed stage consistently melds IoT gadgets (e.g., wearable sensors and insightful drug bundles) with in-home social insurance administrations (e.g., telemedicine) for enhanced client experience and administration effectiveness. The achievability of the actualized iHome Health-IoT stage has been demonstrated in field trials.

IoT devices are used in many fields which make the users' day to day life more comfortable. These smart devices are used to collect temperature, blood pressure, sugar level, pulse rate, heart rate, SpO2 concentration etc., which are used to evaluate the health condition of the patient wherever they are, with onward transmission and storage to the cloud, from where they can be accessed by the physician (Pawar, & Kulkarni, 2014).

The information from the United States National Ambulatory Medical Care Survey (NAMCS) has implications for several core proficiencies needed in the practice of ambulatory medicine. These core proficiencies include coordination of care, medication prescribing, documentation of care, cost containment, evidence-based decision making, patient-centered communication, discharge planning, patient education and promotion of healthy behavior, and integration of prevention into practice (Barker, 2007).

Long before the advent of hospitals and hospital- based care, most health care services were provided in what we now define as ambulatory care settings. In the early 1900s, much of the medical care in the United States was provided either by solo medical practitioners who worked in privately owned offices or by physicians who traveled to provide care in their patients' homes. At that time some physicians chose to locate their offices in their own homes or in small office buildings, as opposed to today's large medical office buildings and medical clinics. The limited amount of technology used in the past allowed physicians to easily pack their supplies and travel from patient to patient.

Home care was not only commo n but also very popular at that time – especially among wealthier patients, who could afford to request house calls to obtain their needed care. Physicians often visited homes via horse and buggy, and the time spent in travel between patients seriously limited the number of patients that one provider could visit in a single day. For the poor and indigent patients of that time, the scenario was much different. They did not have the benefit of affording home care or private physician care; rather, they sought care at community health care clinics that were established specifically to serve their needs. Their health care when care was available was usually limited to such public and philanthropic clinics (Williams, & Torrens, 2008).

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Since the nineteenth century there was the steady development of outpatient clinics owned by acute care hospitals, especially in urban settings where indigent populations did not have access to private medical services. (Sultz, & Young, 2009). Once the growth of not-for-profit hospitals began in the early twentieth century, outpatient clinics became a means for the hospitals to fulfill part of their charitable mission to serve the indigent populations who needed better access to private medical care. The number of hospitals grew quickly at that time as sanitation increased, hospital infections decreased, and antiseptic surgery began to be practiced (Raffel, & Barsukiewicz, 2002).

By 1916, 495 hospitals had opened ambulatory outpatient clinics (Roemer, M.I., 1981). These hospital outpatient clinics also became popular settings for teaching and training young physicians, who commonly agreed to staff the ambulatory clinics in return for hospital admitting privileges. The image of the time was that the outpatient clinics were the “stepchild” of the acute care hospitals and that the patients there were given low priority. The staff at these clinics were almost exclusively young professionals in training, reinforcing this inferiority. J. H. Knowles, the director of Massachusetts General Hospital during this time, wrote: “Turning to the outpatient department of the urban hospital, we find the stepchild of the institution. Traditionally, this has been the least popular area in which to work, and as a result, few advances in medical care and teaching have been harvested here for the benefit of the community” (Knowles, 1965, p.65).

As cars became popular and other types of transportation also improved after World War II, travel became much easier for physicians, and some patients were able to travel to physicians' offices as well (Raffel. & Barsukiewicz, 2002). Advances in medical knowledge and the expansion of medical technology allowed some dramatic changes to begin to take hold. Hospitals expanded and diversified their services in the 1970s and 1980s to accommodate the demand linked to the increase in Medicare, Medicaid, and privately insured patients, which led hospital bills to rise. It did not take the third-party payers long to figure out that it would be less costly to test, diagnose, and treat patients as outpatients instead of admitted inpatients, this shifted the emphasis from inpatient-based care to outpatient-based care. Many medical centers responded to this shift by increasing their ambulatory care service offerings and expanding their outpatient care departments. Groups of medical providers also began organizing and going into business at satellite locations (i.e., locations outside hospital property), setting up new outpatient facilities in local shopping centers and in freestanding medical clinics. This move allowed them to offer services at a lower cost than the hospitals charged and in settings that were more convenient for patients to access (Gottfried, 2008).

During the 1980s, the status of hospital outpatient clinics also changed in a dramatic way. The “stepchild” image had all but disappeared, and the outpatient clinics began to earn recognition as vital portions of the U.S. health care system, portions that were a source of inpatient admissions and of a solid revenue stream from the use of hospital ancillary services. The earnings of outpatient clinics were only approximately 13 percent of total hospital revenues in the year 1980, but that number increased dramatically throughout the decade and into the 1990s to 35.2 percent of total

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hospital revenues. Once a setting that was used only for young physicians and medical students who needed to refine their skills, outpatient clinics now became well organized and staffed by private physician groups who transformed the ambulatory settings into well-equipped, aesthetically pleasing locations for competent medical care that emphasized excellence in customer service (Sultz, & Young, 2009).

The 1990s continued to be a period of growth in both the number of ambulatory care centers and also in the types of care services that were offered. Some ambulatory settings have continued to be general practice clinics, and some (such as cancer care centers and endocrinology clinics) have evolved to meet the needs of patients who have specialized medical requirements. Many facilities have now expanded to offer outpatient chemotherapy, diagnostic imaging, dialysis, pain management services, physical therapy, cardiac rehabilitation programs, outpatient same-day surgery, occupational therapy, women's health care, and wound care services (Sultz, & Young, 2009). These specialty outpatient clinics have been attractive to private physicians and to researchers because they draw a narrow clientele with common needs. These clinics then have the opportunity to truly advance the knowledge and care in their specialty areas, and their patients benefit from having access to the highly trained professionals who have researched and developed innovative ways to diagnose and care for the patients' conditions. (Evans, 2015)

Centers for Disease Control and Prevention (CDC) data published in 2011 show that from the years 1997 to 2007 (Figure 2.1), the number of ambulatory care visits continued to grow by 25 percent (Schappert, & Rechtsteiner, 2011). Also, it is noted that ambulatory care is now the predominant mode of health care delivery in the United States, and in other countries including Nigeria, although there are no records for this. Hospital outpatient clinics, especially those located in urban areas, continue to function as the community's safety net for poor and marginalized populations. Regardless of the type of patient to be served, the historical growth and professional development of physicians, the technological advances in medical equipment, and the advent of specialty clinics allow patients of all means and conditions the potential for excellent medical care in outpatient settings. (Sultz, & Young, 2009).

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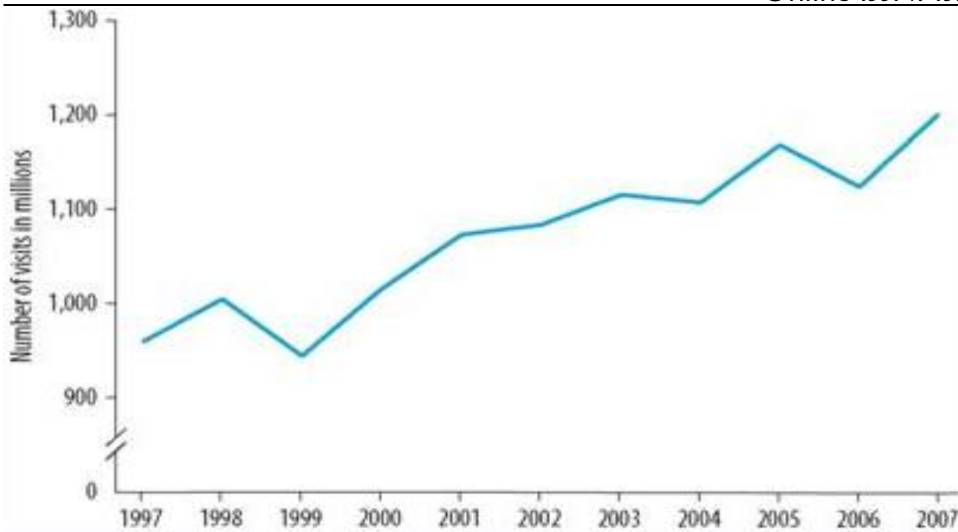

Fig 3.1 **Annual** Number of Ambulatory Care Visits: United States, 1997-2007
Source: (Schappert, & Rechtsteiner, 2011).

Technological advances have made home care via e-visits and other telehealth solutions a viable component of outpatient care. Telehealth is the use of electronic means to provide health care to patients who are outside the health care setting. The technologies involved can range from a simple phone call or email exchange to videoconferencing, streaming media, remote monitoring and robotics.

E-visits, one aspect of telehealth, are really taking off. These virtual visits are a convenient means for an established patient to discuss a specific health care issue, such as a minor illness or well-controlled chronic condition, with a caregiver without the patient has to leave home. Instead of going to see a doctor or nurse practitioner in person, the patient can exchange messages with the caregiver via a secure electronic communications portal. E-visits also are covered by some insurers.

There are two models for e-visits: synchronous, in which the physician and patient communicate directly with one another in real time; and asynchronous, in which the physician and patient can post messages for one another at different times.

The design implications of e-visits and other telehealth solutions depend on the level at which a health care organization plans to provide this type of service. Digital exam rooms with the appropriate equipment, lighting and acoustics are essential for successful telehealth implementation (Dias, Kittredge, & Stouffer, 2013).

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Physician characteristic	Number of visits in thousands (standard error in thousands)	Percent distribution (standard error of percent)	Number of visits per 100 persons per year[1–3] (standard error of rate)
All visits	883,725 (30,070)	100.0 …	277.9 (9.5)
Physician specialty[4]			
General and family practice	202,494 (18,247)	22.9 (1.8)	63.7 (5.7)
Pediatrics[5]	136,119 (16,931)	15.4 (1.7)	173.3 (22.4)
Internal medicine	81,701 (10,328)	9.2 (1.1)	25.7 (3.2)
Obstetrics and gynecology[6]	73,198 (8,457)	8.3 (0.9)	54.8 (6.5)
Dermatology	49,947 (5,533)	5.7 (0.6)	15.7 (1.7)
Ophthalmology	46,289 (4,068)	5.2 (0.5)	14.6 (1.3)
Orthopedic surgery	30,114 (4,280)	3.4 (0.5)	9.5 (1.3)
Psychiatry	29,993 (4,049)	3.4 (0.5)	9.4 (1.3)
Otolaryngology	28,965 (3,489)	3.3 (0.4)	9.1 (1.1)
Cardiovascular diseases	27,783 (4,581)	3.1 (0.5)	8.7 (1.4)
Urology	26,153 (4,298)	3.0 (0.5)	8.2 (1.4)
General surgery	15,685 (2,651)	1.8 (0.3)	4.9 (0.8)
Neurology	14,407 (2,471)	1.6 (0.3)	4.5 (0.8)
All other specialties	120,875 (13,379)	13.7 (1.4)	38.0 (4.2)
Professional identity			
Doctor of medicine	824,581 (29,007)	93.3 (0.9)	259.3 (9.1)
Doctor of osteopathy	59,144 (7,925)	6.7 (0.9)	18.6 (2.5)
Specialty type[4]			
Primary care	481,963 (26,921)	54.5 (1.9)	151.6 (8.5)
Medical specialty	234,521 (17,122)	26.5 (1.8)	73.7 (5.4)
Surgical specialty	167,241 (9,892)	18.9 (1.2)	52.6 (3.1)
Geographic region			
Northeast	184,172 (13,208)	20.8 (1.4)	332.0 (23.8)
Midwest	187,186 (12,556)	21.2 (1.4)	279.6 (18.8)
South	317,747 (21,309)	36.0 (1.8)	264.7 (17.8)
West	194,620 (13,842)	22.0 (1.4)	257.6 (18.3)
Metropolitan status[7]			
MSA	819,106 (31,780)	92.7 (1.3)	299.0 (11.6)
Non-MSA	64,619 (11,770)	7.3 (1.3)	146.7 (26.7)

Source :(NAMCS, 2016)

Fig 3.2 Physician office visits, by selected physician characteristics: United States, 2016

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Physician practice characteristics	Number of visits in thousands (standard error in thousands)	Percent distribution (standard error of percent)
All visits	883,725 (30,070)	100.0 ...
Employment status		
Full-owner	312,703 (26,358)	35.4 (2.7)
Part-owner	215,778 (22,360)	24.4 (2.4)
Employee	321,250 (25,628)	36.4 (2.7)
Contractor	*30,273 (9,112)	3.4 (1.0)
Blank[1]	*3,721 (2,222)	0.4 (0.3)
Ownership		
Physician or group	661,158 (31,589)	74.8 (2.3)
Other health care corporation	73,100 (14,277)	8.3 (1.6)
Other hospital	67,856 (12,870)	7.7 (1.4)
Medical or academic health center	19,317 (5,659)	2.2 (0.6)
HMO[2]	*13,309 (6,715)	1.5 (0.8)
Other[3]	*11,057 (4,939)	1.3 (0.6)
Blank[1]	37,928 (9,671)	4.3 (1.1)
Practice size		
Solo	281,330 (24,717)	31.8 (2.6)
2	73,737 (15,099)	8.3 (1.7)
3–5	270,433 (26,299)	30.6 (2.7)
6–10	152,925 (18,826)	17.3 (2.1)
11 or more	103,768 (15,095)	11.7 (1.7)
Blank[1]	*1,532 (1,242)	0.2 (0.1)
Type of practice		
Single-specialty group	364,324 (28,289)	41.2 (2.8)
Multispecialty group	234,715 (23,566)	26.6 (2.5)
Solo	281,330 (24,717)	31.8 (2.6)
Blank[1]	*3,355 (2,155)	0.4 (0.2)
Office type		
Private practice	793,127 (30,717)	89.7 (1.7)
Freestanding clinic or urgicenter	54,204 (12,961)	6.1 (1.4)
Other[4]	36,394 (10,349)	4.1 (1.2)
Electronic medical records		
Yes—all electronic	654,761 (32,604)	74.1 (2.4)
Yes—part paper and part electronic	123,827 (16,988)	14.0 (1.9)
No	104,890 (14,539)	11.9 (1.6)
Blank[1]	* ...	0.0 (0.0)
Practice submits claims electronically		
Yes	812,721 (31,210)	92.0 (1.4)
No	64,376 (11,701)	7.3 (1.3)
Blank[1]	*6,628 (3,996)	0.8 (0.5)

Source :(NAMCS, 2016)

Fig 3.3 Physician office visits, by selected physician characteristics: United States, 2016

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Patient age and sex	Number of visits in thousands (standard error in thousands)	Percent distribution (standard error of percent)	Number of visits per 100 persons per year[1] (standard error of rate)
All visits	883,725 (30,070)	100.0 ...	277.9 (9.5)
Age (years)			
Under 15	156,860 (16,160)	17.7 (1.6)	257.4 (26.5)
Under 1	29,211 (4,066)	3.3 (0.4)	736.1 (102.5)
1–4	45,013 (4,648)	5.1 (0.5)	282.2 (29.1)
5–14	82,636 (9,597)	9.4 (1.0)	201.5 (23.4)
15–24	65,077 (4,433)	7.4 (0.4)	153.0 (10.4)
25–44	170,734 (8,924)	19.3 (0.9)	205.4 (10.7)
45–64	252,037 (11,468)	28.5 (0.9)	301.9 (13.7)
65 and over	239,016 (10,814)	27.0 (1.0)	498.5 (22.6)
65–74	132,148 (6,579)	15.0 (0.6)	465.2 (23.2)
75 and over	106,868 (5,536)	12.1 (0.6)	546.8 (28.3)
Sex and age (years)			
Female	512,192 (19,436)	58.0 (0.9)	315.0 (12.0)
Under 15	73,886 (9,243)	8.4 (0.9)	247.7 (31.0)
15–24	40,969 (3,600)	4.6 (0.4)	194.4 (17.1)
25–44	118,727 (7,026)	13.4 (0.7)	281.8 (16.7)
45–64	145,010 (7,472)	16.4 (0.7)	337.2 (17.4)
65–74	70,787 (4,045)	8.0 (0.4)	467.9 (26.7)
75 and over	62,813 (3,827)	7.1 (0.4)	549.9 (33.5)
Male	371,533 (14,578)	42.0 (0.9)	239.0 (9.4)
Under 15	82,975 (7,993)	9.4 (0.8)	266.7 (25.7)
15–24	24,108 (2,029)	2.7 (0.2)	112.3 (9.4)
25–44	52,007 (3,804)	5.9 (0.4)	126.9 (9.3)
45–64	107,027 (6,185)	12.1 (0.6)	264.4 (15.3)
65–74	61,361 (3,528)	6.9 (0.4)	462.2 (26.6)
75 and over	44,055 (2,609)	5.0 (0.3)	542.4 (32.1)

Source :(NAMCS, 2016)
Fig 3.3 Office visits, by patient age and sex: United States, 2016

CONCLUSION

This review work will go a long way in health monitoring system since it involves the use of IoT. Any abnormalities in the health conditions can be known directly and are informed to the particular person through Wi-Fi internet connection. The system is simple, power efficient and easy to understand. It acts as a connection between patient and doctor. The hardware for the project is available to be implement and the output results would be compared with a known standard.

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Recommendation

1. It is recommended to cooperate the use of Wi-Fi as our source of internet and with the current advances and prospects in this field of IoT's, one of its main use is in healthcare, for real time monitoring of health parameters, and sending it to the cloud for storage and accessibility. This review work proposed the use of IoT's, along with a micro-controller, a Wi-Fi module, and biosensors, to monitor the vital signs of human body.

2. Based on the paper reviewed so far, they mainly focus on two parameters mostly temperature and heart rate but recommendations are made for additional parameters which am currently working on five parameters

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