Artificial Intelligence and IoT-Based Nurse Alert Systems for Real-Time Emergencies: A Review

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Abstract

Traditional methods of patient monitoring are largely manual and take time to record, report and alert when emergencies occur. Modern digital technologies - increasingly combining the Internet of Things (IoT) with artificial intelligence (AI) - can make these alert systems respond rapidly, efficiently and cost-effectively. This paper aimed to review various IoT-based nurse alert systems for real-time emergencies. Two research questions were framed to facilitate the selection of papers. They related to the various available IoT-based patient monitoring systems that can be used for nurse alerts, and the benefits and challenges encountered when implementing any of these systems in a given context.

From Google Scholar, 25 papers suitable for answering the two research questions were selected based on defined inclusion and exclusion criteria. The papers identified from Google Scholar were repeatedly screened and selected using the PRISMA process. The search for papers was stopped when the target of 25 papers was achieved.

The results of the review showed that, overall, there is sufficient support from the literature for answers to the two research questions. In answer to the first question, the literature provides several IoT-based nurse alert systems for implementation in different contexts, several of which incorporate AI and machine learning for prediction and decision support. Many benefits and challenges have also been reported in the literature in answer to the second research question. Some limitations of this review are mentioned at the end.

Keywords: artificial intelligence, IoT, cloud, patient monitoring, nurse alerts, real-time emergency

Introduction

In recent years, the Internet of Things (IoT) has gained remarkable prominence and has revolutionised various industries with its ability to connect and communicate seamlessly across different devices. One area that has particularly benefited from the advancements in IoT is the healthcare sector. Among the many applications, the development of IoT-based nurse alert systems for real-time emergencies has garnered tremendous attention. These systems leverage the power of IoT technology to enable nurses to respond swiftly and effectively to critical situations, ultimately saving lives. More recently, the coupling of IoT sensing with artificial intelligence (AI) has enabled alert systems that not only transmit threshold breaches but can also predict patient deterioration in advance, reshaping how nursing workflows respond to emergencies (Wei et al., 2025).

An IoT-based nurse alert system typically consists of several key components that work together to facilitate real-time communication and alerts in healthcare settings. These components include the following:

1. Patient wearable devices: smart wristbands, pendants or buttons that allow patients to signal for help. When pressed, these devices can send alerts directly to the nursing staff.
2. Sensors: various sensors (e.g., motion sensors, health monitoring sensors) can be integrated to monitor patient conditions (e.g., heart rate, respiration or mobility). If any parameters fall outside predefined thresholds, an alert can be triggered.
3. Microcontrollers/gateways: microcontrollers (such as Arduino or Raspberry Pi) act as the central hub that collects data from wearable devices and sensors. They can send alerts via local networks or the internet.
4. Communication network: Wi-Fi, Zigbee, Bluetooth or other wireless communication technologies that connect devices to the hospital's network, ensuring that alerts can be sent quickly to the appropriate staff.
5. Alert management software: software applications that process incoming alerts and notifications, prioritise them, and send them to the appropriate nurses or staff members based on predefined protocols; increasingly, AI models are used at this layer to rank alert urgency and reduce alarm fatigue.
6. Mobile and web interfaces: nurses can receive alerts via mobile apps or web applications, providing real-time notifications about patient needs. These interfaces can also enable monitoring of patient status.
7. Database management system: a database to store patient data, alert history and system logs for compliance and review purposes.
8. Dashboard for monitoring: a centralised dashboard for healthcare staff to visualise real-time data, track alerts and manage patient care more efficiently.
9. Power supply: reliable power sources for wearable and sensor devices, including rechargeable batteries or low-power technologies to extend device life.
10. Integration with Hospital Information Systems (HIS): ensuring that the alert system can integrate with existing HIS for seamless access to patient data and better workflow management.

Additional considerations include data security (implementing encryption and security measures to protect patient data and ensure compliance with healthcare regulations), user training (training staff and patients to use the system effectively to ensure prompt and accurate responses during emergencies) and scalability (designing the system to scale across different departments or facilities as needed). These components work together to create an efficient, responsive and reliable IoT-based nurse alert system that enhances patient care and safety in healthcare environments.

In this review, we explore the concept of an IoT-based nurse alert system and delve into the potential benefits and challenges of implementing such a system in healthcare settings. Hence, the research questions are:

a) What are the applications of IoT-based nurse alert systems for real-time emergencies?

b) What are the benefits and challenges of implementing an IoT-based nurse alert system for real-time emergencies?

Methodology

Google Scholar was searched to identify papers related to the review topic. The PRISMA flow diagram was used to screen and select a targeted 25 papers, and the search was stopped when the target was reached. Only full texts and abstracts containing relevant information published in English were selected. Non-English papers, other abstracts, books, book sections, editorial comments and dissertations were excluded. The 25 papers selected using this methodology are described in two subsections corresponding to the two research questions in the next section. These results are discussed, followed by the Conclusion and Limitations. The PRISMA flow diagram of the selection process is shown in Figure 1.

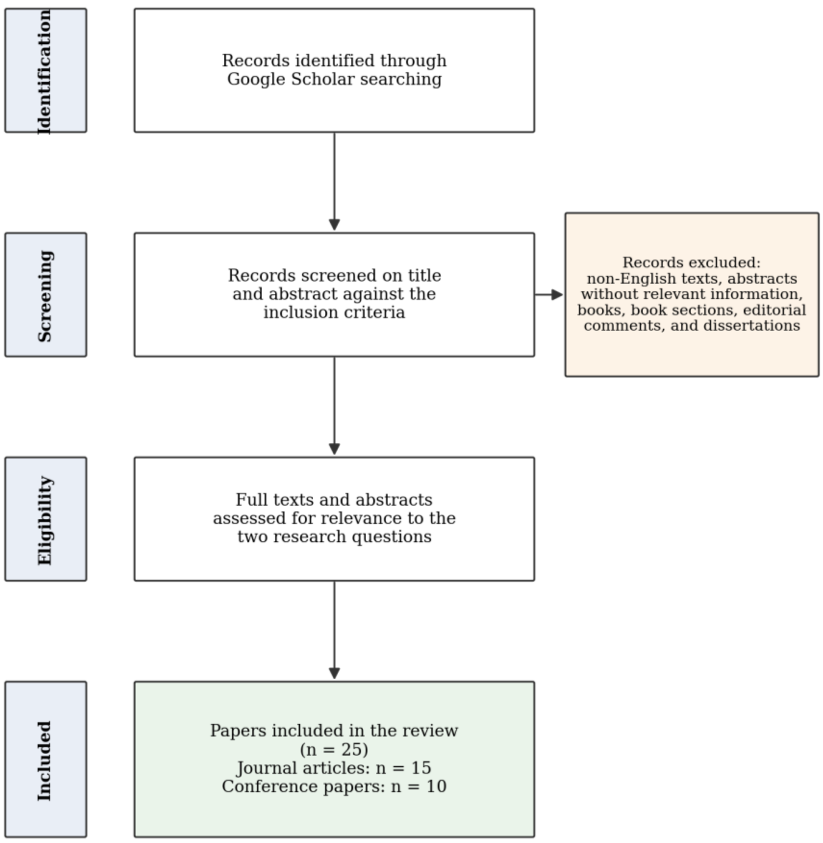

Figure 1. PRISMA flow diagram of the paper selection process

Results

What are the applications of IoT-based nurse alert systems for real-time emergencies?

Debnath et al. (2022) introduced a real-time monitoring system for at-risk patients, which monitors various vital signs such as body temperature, heart rate, blood pressure, oxygen saturation level and electrocardiogram signals. This device is primarily used in the Intensive Care Unit or Operating Room and sends updated data to a hybrid cloud server every 45 seconds. Authorised physicians or nurses can access these data. The authors conducted over 2,000 cycles in a day, measuring and storing all biomedical parameters. Additionally, the system includes an alarm system and emergency SMS alerts via GSM technology to prompt appropriate actions during emergencies. The device acts as an alert system for healthcare professionals, including nurses. The device was tested on 10 patients, and the results were satisfactory. A block diagram of the system provided by the authors is given in Figure 2.

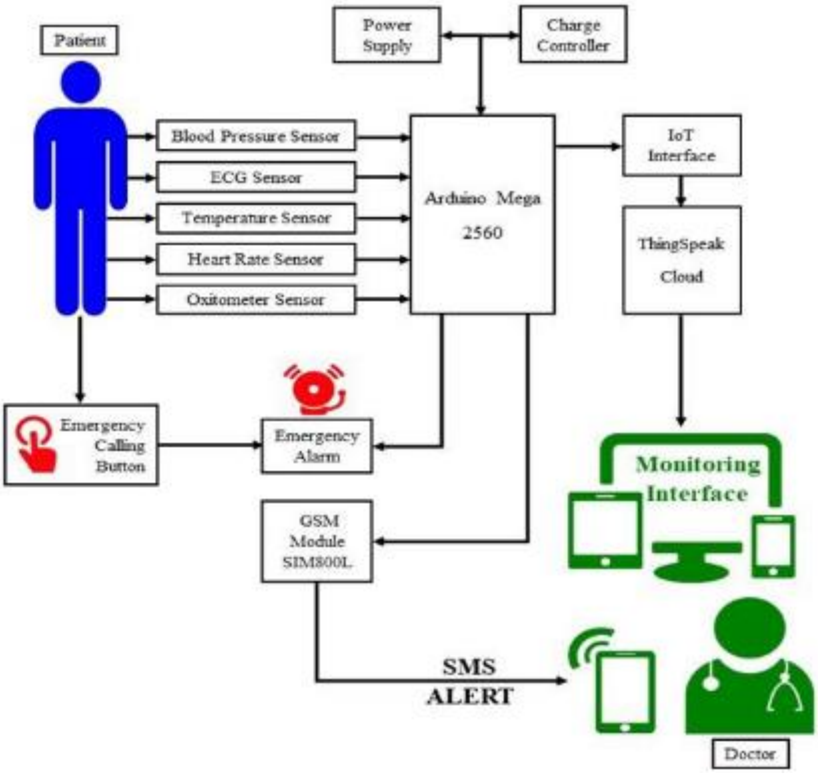

Figure 2. A block diagram of the proposed system (Debnath et al., 2022)

Tsao et al. (2022) created a system for emergency and pre-hospital transportation that uses IoT technology. This system allows for seamless communication and data sharing between five different health devices: blood oxygen sensors, blood pressure sensors, forehead temperature sensors, body temperature sensors and body weight sensors. A central controller, accessed through RFID technology, gathers and stores the health profiles of clients on a cloud platform. The collected data can be easily shared, analysed and visualised. Additionally, the system can accommodate changes in the health devices, allowing for the addition or removal of sensors as needed. By utilising the MQTT protocol, all devices can communicate with each other and be integrated into a comprehensive health measurement standard, such as measuring blood pressure in conjunction with weight or body temperature alongside blood oxygen levels. The authors successfully implemented a smart healthcare monitoring system (SHMS) and verified its reliability, and used MQTT as an open communication format that can be adopted by other organisations for individual patient vital-sign monitoring in various applications. The system architecture of the proposed system and its workflow are presented in Figure 3.

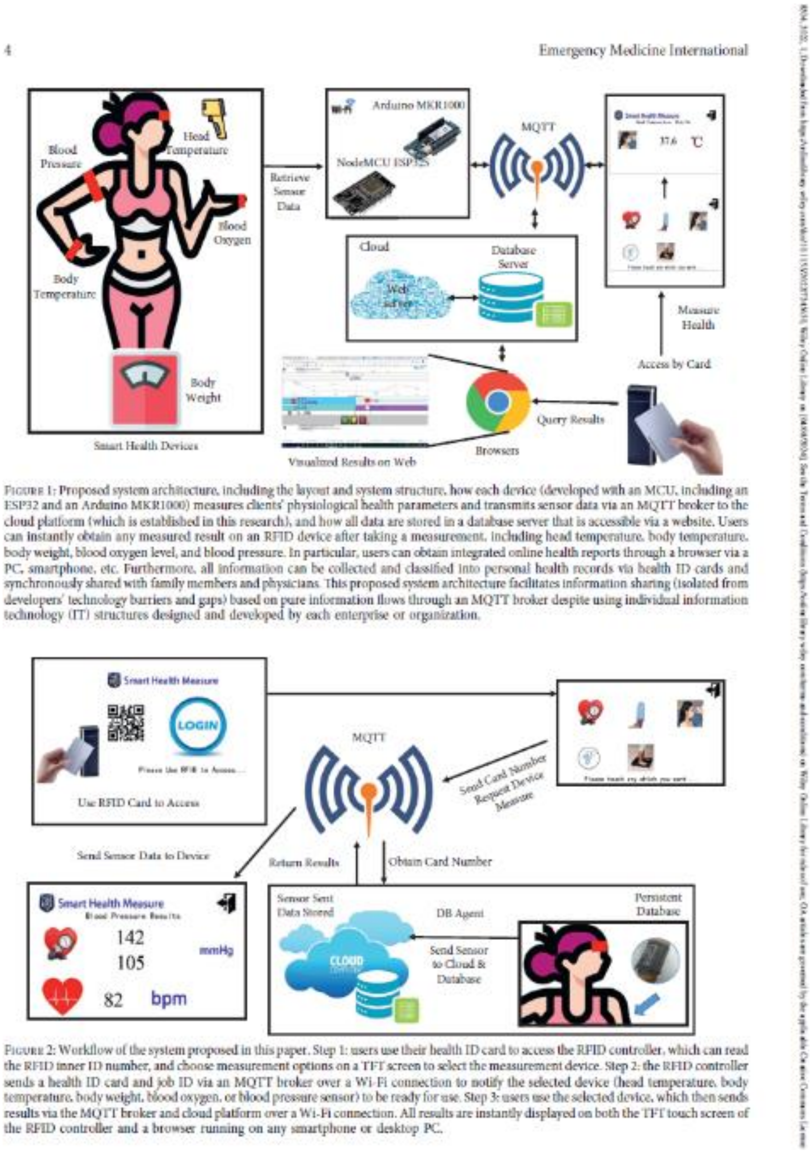

Figure 3. System architecture and workflow of the proposed emergency monitoring system (Tsao et al., 2022)

A wireless nurse calling system was proposed by Riyad et al. (2021) as a solution for patients to easily contact a nurse during emergencies. Instead of the expensive hard-wired systems commonly found in hospitals, this system proposes using a wireless network. Previous attempts at implementing a wireless nurse calling system had limited coverage, but this project uses a widely accessible and affordable Wi-Fi network. The main components of this system are the Wi-Fi module ESP8266 and a server. The system can be adapted to different scales, allowing for features such as automatic attendance and location detection, and it bridges the gap between management and nurses by monitoring real-time calls.

Uddin et al. (2017) proposed an automatic intelligent patient monitoring system for monitoring a patient's health condition using sensor-based connected networks. Several sensors are used for gathering the biological behaviours of a patient. The meaningful biological information is then forwarded to the IoT cloud. The system can detect the critical condition of a patient by processing sensor data and instantly provides push notifications to doctors and nurses as well as hospital in-charge personnel. Doctors and nurses benefit from this system by observing their corresponding patients remotely without visiting in person.

Aditya et al. (2020) proposed a real-time patient activity monitoring and alert system consisting of both hardware and software components at both the patient and doctor ends, to classify the activities of the patient as normal or abnormal using a web camera and temperature sensor. If the patient's state is abnormal, an alert notification is sent to the doctor. The system compares, captures and generates alert messages regarding the patient's condition using the sensors and a GSM module. Thus, the proposed system provides an efficient monitoring system for effective healthcare services for ICU patients.

Ullah et al. (2023) aimed to create a system that addresses the issue of backward blood flow preventing saline fluid from flowing, while also monitoring various patient parameters such as temperature, heart rate and oxygen level through the use of multiple sensors, including weight and temperature sensors. Furthermore, the proposed system also monitors room temperature and humidity, ensuring the patient's overall comfort. In emergencies, an emergency push button alerts medical staff promptly and allows for timely interventions. The intention behind this system is to assist nurses and doctors in effectively monitoring patients and providing necessary interventions to prevent complications. To assess the precision of the nurse activities monitoring and control device, the authors conducted tests on twenty resting patients. For measuring body temperature, oxygen level, heart rate and room temperature, standard tools such as a regular thermometer, oximeter, heart rate scanner and temperature sensor were used, and the data obtained from these tools were compared with the device; both systems produced similar results. The system architecture of the proposed system is shown in Figure 4.

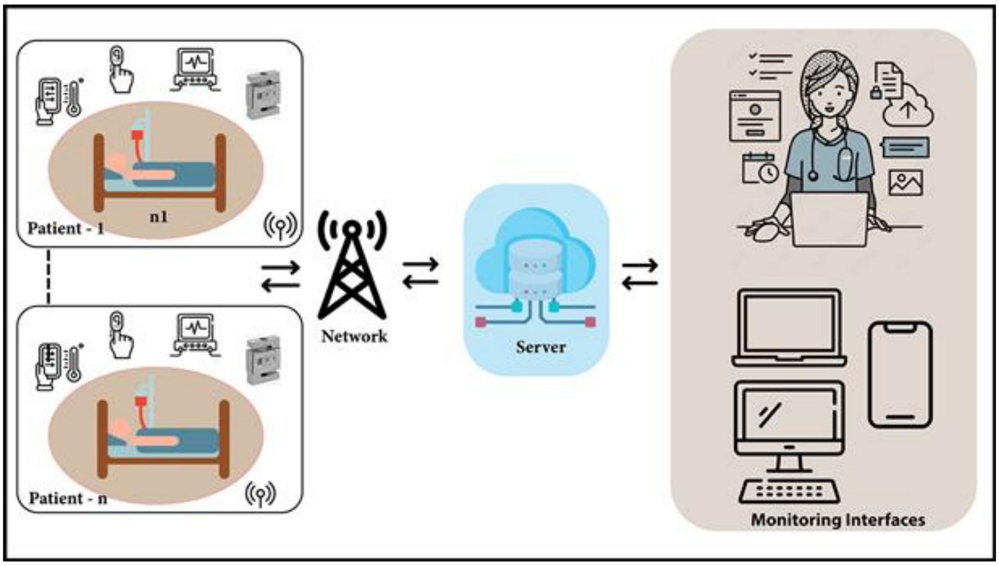

Figure 4. System architecture of the proposed system (Ullah et al., 2023)

Ahmed et al. (2022) aimed to create a cost-effective and user-friendly health monitoring system that can be used by healthcare professionals and patients in real time. The proposed system combines IoT technology with telemedicine to monitor patients' vital signs. It includes various IoT sensors to measure body temperature, heart rate, ECG, SpO2 levels, blood pressure and glucose levels. The sensors are connected to analogue inputs, and their readings are amplified by the microprocessor. Doctors and nurses can remotely diagnose ailments using the collected data. A medical treatment plan, created by doctors and connected to an Arduino microprocessor, measures patients' vital signs. The readings are then transmitted to an Android application on a smartphone via a Bluetooth module, enabling efficient communication between patients and healthcare professionals. The Android application updates a MySQL database, which in turn displays the readings on a website accessible to both doctors and patients. After successful simulation trials, the system was tested on five human patients and showed high accuracy in all measurements.

More et al. (2016) proposed a system using removable media or mobile phones to store encrypted patient biomedical data, which can only be accessed by authorised medical staff. The system can be implemented using Java and utilises cost-effective technology. It focuses on measuring parameters such as ECG, temperature and blood levels. The system includes a body area network and an Android smartphone for features such as patient localisation, data storage, monitoring movements, and transmitting data and alerts to first responders and the hospital server. Data are transferred via Bluetooth to a coordinator node, and an administrator can send data or commands back to the system. A microcontroller hardware board connects to a PC to maintain a centralised database or log. GUI-based software displays vital information graphically, allowing the administrator to adjust alarm thresholds for individual patients via SMS or the GUI application. The system proposed by the authors is given in Figure 5.

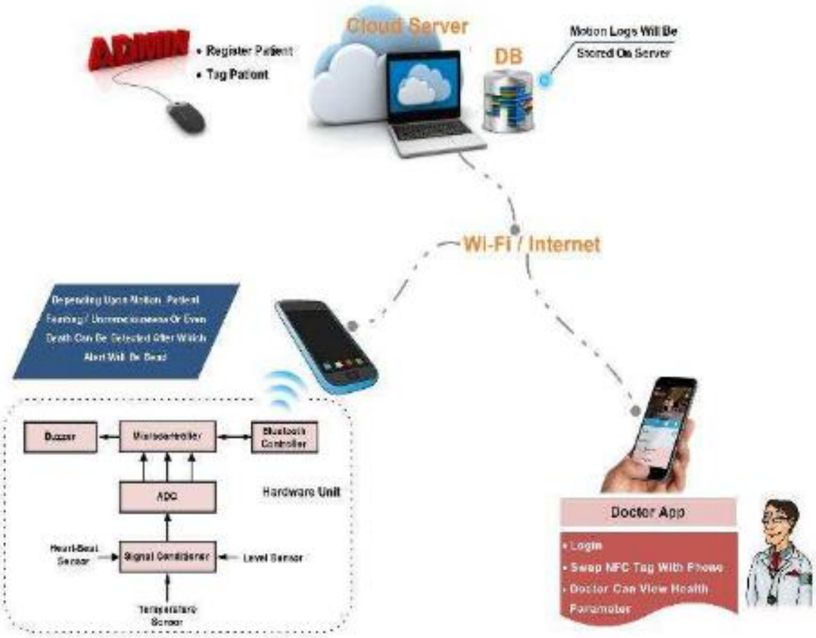

Figure 5. The IoT-based BSN healthcare system for emergency response proposed by More et al. (2016)

The i-MsRTRM framework (Intelligent Medicare System for Real-Time Remote Health Monitoring) utilises advanced models and web services in the cloud to efficiently provide remote health monitoring. Equipped with advanced sensors, the system also includes an emergency assistance module. In level 1, the system contacts the doctor/caregiver and family, and if this level is unsuccessful, level 2 is initiated. Real-time data values from sensors are sent to the cloud for storage, where each parameter is treated as database storage for the data of each patient. On-server processing is used to compare these data values against thresholds. The thresholds are generated based on previous processing periods and then transmitted to the Emergency Assistant Gateway (EAG). The EAG determines whether the breaches are inter-related or pose a higher threat, and assigns a threat level based on the severity of the emergency, divided into three levels. The emergency system developed by Patel et al. (2016) is shown in Figure 5. Only the patient location capability of the system, using GPS, appears to have been tested by the authors.

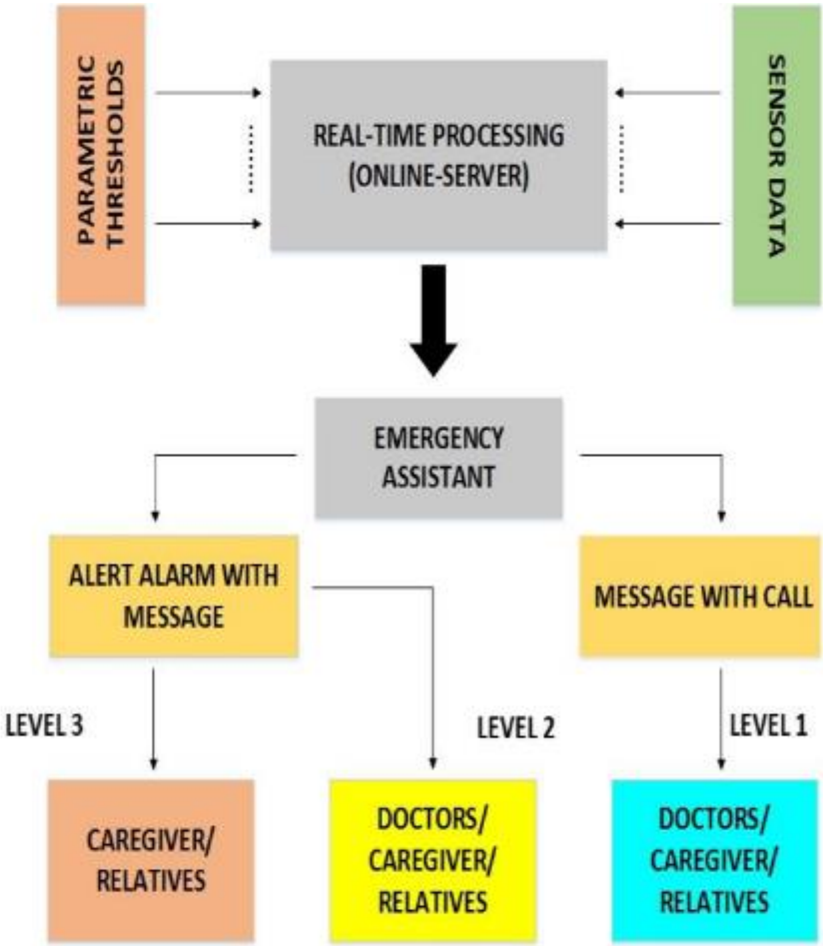

Figure 6. The emergency system developed by Patel et al. (2016)

Most ICU devices are equipped with various sensors to measure health parameters, but monitoring them all the time is still a challenging job. Prajapati et al. (2018) proposed an IoT-based system that can help with fast communication, identify emergencies, initiate communication with healthcare staff, and support proactive and quick treatment. This healthcare system reduces the possibility of human error and delays in communication, and helps doctors devote more time to decisions with accurate observations. The architecture of the proposed system is given in Figure 7.

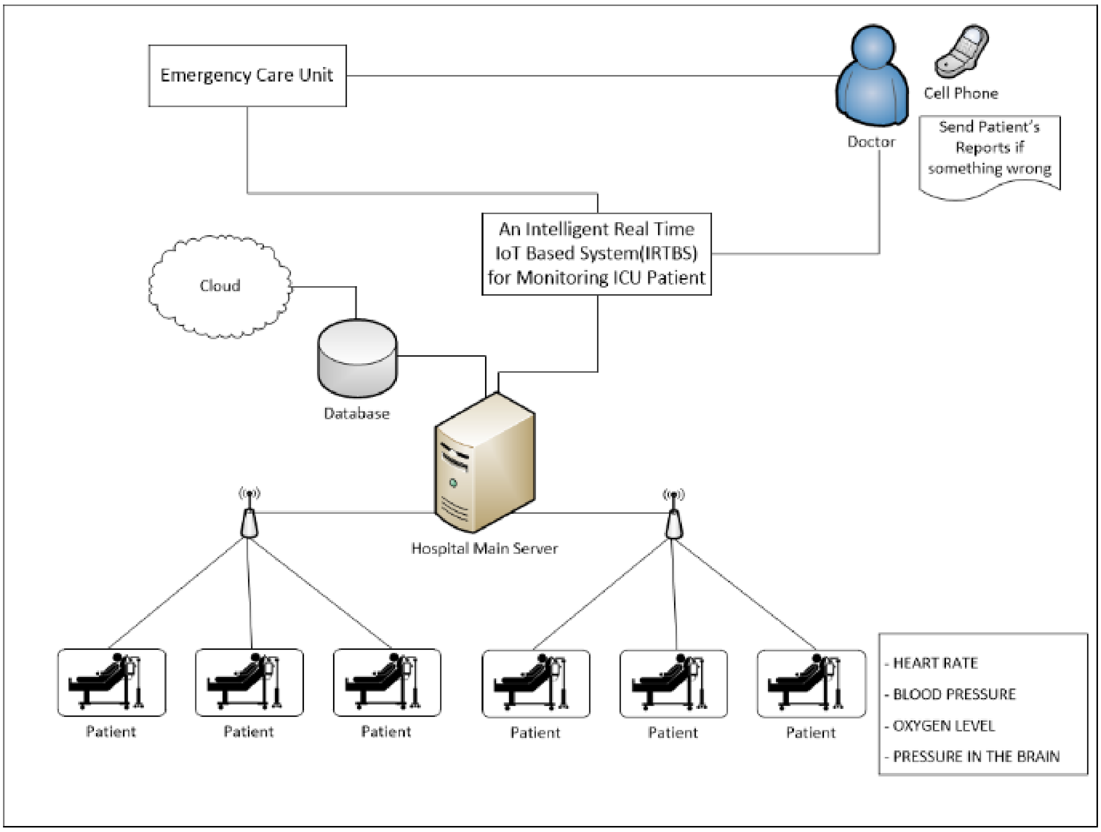

Figure 7. An intelligent real-time-based ICU patient monitoring system (Prajapati et al., 2018)

A remote monitoring system was proposed by Mohammed and Hasan (2023) to measure body temperature (DS18B20), heart rate and SpO2 (MAX30100), and the position of the patient. These data can be obtained on demand using a SIM7600E GSM and GNSS HAT (hardware attached on top) module. A Raspberry Pi 4B was used as a microcontroller to gather data from health parameter sensors. The data from sensors were transmitted to cloud storage through a network. The proposed system used the latest generation of IoT microcontrollers and devices, which significantly improved the precision and speed of the whole system. A GUI cross-platform mobile application was developed for presenting real-time data to both doctors and patients. The system is beneficial for synchronous monitoring of a patient's health status, allowing urgent medical decisions by doctors at the right time.

Khan et al. (2020) presented a novel system, WISE, a wearable IoT-cloud-based health monitoring system for real-time personal health monitoring. WISE adopted the framework of the body area sensor network (BASN) to support real-time health monitoring for remote control and advice by sharing information in an authenticated manner. The system was designed with scalable algorithms to track large numbers of patients, an intuitive interface to assist overworked responders, and ad-hoc mesh networking capabilities to maintain access to patients in chaotic environments.

Al-Zidi et al. (2021) proposed a remote patient monitoring system using the IoT. The system constantly monitors a patient's basic vital signs, including body temperature, heartbeat rate and blood pressure. A wearable device with a microcontroller, Wi-Fi module and sensors is used as the main component of the system. These sensors capture the patient's vital signs, which are transmitted to a cloud database through the Wi-Fi module. Using an Android-based smartphone application or a website, doctors can monitor the patient's condition in real time or access previously recorded data. Additionally, the system sends a notification to the doctor's application if any of the vital signs cross a predetermined threshold. This real-time remote patient monitoring system enables the early detection of critical conditions, potentially saving lives.

Overall, most systems with applications as nurse alert systems for real-time emergencies are IoT-based, and they monitor broadly similar health parameters. The emergency context varies - for example, ICUs, aged care and patients with disabilities. In many cases, the data are referred to doctors for immediate attention; however, the data may also be sent to nurses for immediate care.

What are the benefits and challenges of implementing an IoT-based nurse alert system for real-time emergencies?

The papers related to the benefits and challenges of implementing IoT-based nurse alert systems are reviewed in this section. Some of the papers reviewed above provide information about the benefits and challenges of the systems they propose; additional papers dedicated to the benefits and challenges of IoT-based healthcare systems for emergencies are reviewed here.

According to Hossain et al. (2022), IoT-based healthcare systems are the most practical and economical solution for people of all ages to treat and prevent diseases. The benefits listed by Latif et al. (2020) for their I-CARES system are continuous health monitoring, scheduled timely medication, unscheduled emergency medication, life-saving emergency reporting, life-saving emergency prediction and early-stage diagnosis. In addition, based on the analysis reports, physicians can diagnose and decide, view medication side effects and medication errors, and prescribe medication accordingly. Some benefits have also been listed by Lu et al. (2021). These systems enhance the intelligence of the healthcare sector. By facilitating remote diagnosis and treatment collaborations, they help expedite the accessibility and effectiveness of these services. When combined with medical IoT, real-time vital-sign data of patients can be collected, and an AI model algorithm can be deployed to identify early risks among patients in the NICU and CCU, provide treatment recommendations and predict treatment outcomes. In emergency care, the integration of AI and IoT can enable swift and precise diagnosis and treatment, allowing for timely rescue efforts and saving lives. The early identification and timely intervention of high-risk patients with VTE can lower the incidence of VTE and enhance patients' quality of life. Moreover, the real-time presentation of patients' vital-sign data with intelligent outlier identification can significantly enhance monitoring capabilities and ensure patient safety. Lastly, AI technology enables more accurate and efficient medical image recognition and diagnosis.

The framework proposed by Mahmoud et al. (2020) bridges the divide between present technologies and healthcare systems. It combines various elements, including the wireless body area network (WBAN), cloud computing, fog computing, semantic ontology and a clinical decision support system (CDSS), to create a comprehensive and all-encompassing model. This model enables physicians to monitor individuals with chronic ailments in real time, thereby empowering them to provide patients with appropriate guidance. Moreover, patients can maintain a normal lifestyle, as there is no requirement for them to remain hospitalised. This not only saves money but also improves the patient experience.

A ubiquitous, intuitive IoT-based Help to You (H2U) healthcare system developed by Basanta et al. (2016) integrates various technologies of wearable devices, biosensors and wireless sensor networks to provide an intensive service management platform. This method supports real-time activity, monitors the healthcare system for elderly citizens, and connects people, doctors and practitioners in an emergency with the right information. The system increases accessibility, efficiency, security, safety, comfort and management of the daily routines of elderly life at lower health costs.

IoT-based remote patient monitoring systems enhance reliability, timeliness, security, efficacy and adaptability. The entire health surveillance system can be integrated into a small, compact unit as small as a cell phone or a wristwatch, which helps patients carry the device easily anywhere (Lakshmi et al., 2021). Tôn and Lê (2019) observed that patients benefit from smart healthcare solutions where real-time data are exchanged to help medical practitioners make the necessary decisions. A lightweight wearable device relies on data-driven communications to keep people connected purposefully in instances such as fire-fighting, prompting fast-food clients and medical treatment. Wearables can be programmed semi-automatically to enact a medical rule-based alert process that assists hospital doctors in taking care of outbreak patients. This flexible business process allows customised medical treatment for dengue and measles to fit the outbreak scale and patient demographics.

Qualitative evidence also indicates that nurses view AI-supported monitoring and alerting as an opportunity to improve response times and patient safety, provided that workload, training and ethical concerns are addressed alongside the technology itself (Almagharbeh et al., 2025).

The challenges listed by Lu et al. (2021) for IoT-based healthcare monitoring are threats to information security, missing IoT data standards, risks due to speciality refinements, ethical issues and a lack of interdisciplinary medical talent. According to Xu et al. (2014), a heterogeneity problem occurs due to the diversity of the objects in IoT. A systematic review by Albahri et al. (2018) highlighted several challenges of real-time remote health monitoring systems, relating to network optimisation, disease monitoring, general healthcare services, healthcare data management, power consumption and energy efficiency, decision support systems, triage, security and privacy, disaster and emergency management, and ambient assisted living (AAL). An automated IoT-based monitoring system for remote patients proposed by Utekar and Umale (2018) addresses the challenges in the implementation of healthcare systems in developing countries. These challenges relate to technology, infrastructure, trained doctors and connectivity among all stakeholders.

The patient monitoring system using IoT and machine learning proposed by Hameed et al. (2020) was a low-cost solution for people in remote areas. They could use it to identify any serious health issues and seek help by contacting nearby hospitals. The proposed system, built on fuzzy neural networks, was also efficient and intelligent enough to provide healthcare facilities.

Monitoring potential COVID-19 patients is a challenge despite many developments in IoT-based patient monitoring systems. Even the system developed by Albogamy (2021) could only detect potentially serious cases of COVID-19 among patients treated in home isolation in a case study to validate the system.

As in the case of the papers reviewed on the various IoT-based patient monitoring systems, when an emergency arises, the first point of care is the nurses in the ward. Hence, the alerts to the doctors from the monitored data apply to nurses also. If the patient is in an emergency ward or ICU, nurses are more likely to observe the data to prevent any negative outcomes. Nurses may adjust an intervention after consulting doctors (or doctors may instruct the nurses) about the alert.

While seven papers dealt with benefits, five papers dealt with challenges. No single paper dealing with both benefits and challenges could be identified; this does not mean such papers do not exist, nor that benefits outweigh the challenges. However, unless the benefits exceed the challenges, it may be difficult to adopt any monitoring system, and more research is required here.

Overall, benefits and challenges are identified when a proposed system is tested in a specific healthcare context. The nature and extent of benefits and challenges may vary when the context is changed; however, no paper dealt with this issue.

Discussion

There was no paper published before 2014, in 2015 or in 2024. The number of papers increased significantly after 2019 (16 out of 25) compared with before 2019 (nine out of 25). However, this does not mean that no papers were published before 2014, in 2015 or in 2024; it is simply that such papers did not appear in the search. The maximum number of papers (14 out of 25) was published during 2020–2022. Journal papers dominated, with 15 of the 25 reviewed papers; the remaining 10 were published as conference papers. There were no other types of publications, such as books, book sections, abstracts without relevant information, or dissertations, as they were excluded.

Beyond these quantitative trends, there are many other points related to the reviewed papers, as discussed below. In this review, attempts were made to answer two research questions by examining 25 papers: (a) What are the applications of IoT-based nurse alert systems for real-time emergencies? and (b) What are the benefits and challenges of implementing an IoT-based nurse alert system for real-time emergencies? We now examine how the reviewed papers answered these two questions.

What are the applications of IoT-based nurse alert systems for real-time emergencies?

Various authors proposed many IoT-based real-time patient monitoring systems to alert nurses in emergencies. Most authors measured similar items in their real-time patient monitoring systems, including temperature, heart rate, blood pressure, oxygen saturation level, ECG signals and a few more depending on the context. Some unique points from the reviewed papers are discussed here.

The paper by Debnath et al. (2022) was unique in dealing with at-risk patients in ICUs and operating rooms. The adequacy of the 45-second frequency of sending updated information may need verification, and it is not known whether the test of the system on 10 patients covered this point. However, the double assurance using alarms and SMS alerts is a strength.

Emergency pre-hospital transportation of patients based on an IoT-based patient monitoring system was created by Tsao et al. (2022). They used sensors attached to the body to measure real-time blood oxygen, blood pressure, forehead temperature, body temperature and body weight. Why the temperatures of the forehead and body were measured instead of either one is not clear. The use of RFID and MQTT for smart healthcare is unique in this paper.

A system for remote monitoring of patients was the unique contribution of the paper by Uddin et al. (2017). Again, several sensors were used to monitor many parameters. The system provides push notifications to doctors and nurses, who are alerted in this manner.

A real-time patient activity monitoring system is particularly useful when connected with both doctors and patients. The system proposed by Aditya et al. (2020) uses a web camera and a GSM module to alert doctors and nurses about their ICU patients. However, there are many similarities between this paper and that of Debnath et al. (2022) discussed above.

The paper by Ullah et al. (2023) addressed the issue of backward blood flow preventing saline fluid from flowing. The comfort of patients was an additional parameter, measured using room temperature and humidity. Otherwise, the system measured the usual variables such as heart rate, temperature and oxygen levels using sensors across the body.

Cost-effectiveness and user-friendliness were two unique aspects considered by Ahmed et al. (2022). The use of analogue systems with microcontrollers harks back to older designs; Android smartphones displaying the real-time readings from the website are used for communicating the alerts.

Removable media or mobile phones to store encrypted patient biomedical data with access restricted to authorised persons ensure the protection of security and privacy, the two major challenges of IoT systems. Android smartphones for alerts, a microcontroller hardware board connected to a PC to maintain a centralised database or log, and GUI-based software displaying vital information graphically - allowing the administrator to adjust alarm thresholds for individual patients via SMS or the GUI application - are some unique features of the system proposed by More et al. (2016).

The i-MsRTRM framework is a new idea, as it uses the latest versions of software; an emergency assistance module is available in this system proposed by Patel et al. (2016).

An IoT-based system built for speed was the unique aspect of the system proposed by Prajapati et al. (2018). While being fast, the system also reduces the possibility of human error and delays in communication, and helps doctors devote more time to decisions with accurate observations.

A system beneficial for synchronous monitoring of a patient's health status, allowing urgent medical decisions by doctors at the right time, was proposed by Mohammed and Hasan (2023), which was otherwise a routine one.

A system scalable for monitoring many patients at a time was the unique feature of the model called WISE suggested by Khan et al. (2020).

The use of an Android smartphone or a website to send a notification to the doctor's application if any of the vital signs cross a predetermined threshold was the unique feature of the system proposed by Al-Zidi et al. (2021).

What are the benefits and challenges of implementing an IoT-based nurse alert system for real-time emergencies?

The benefits commonly discussed by various authors for the systems they developed are efficiency, effectiveness, rapidity and precision. The challenges commonly mentioned are concerns of security and privacy.

Practicality and cost-effectiveness were pointed out by Hossain et al. (2022). The benefits listed by Latif et al. (2020) are continuous health monitoring, scheduled timely medication, unscheduled emergency medication, life-saving emergency reporting, life-saving emergency prediction and early-stage diagnosis. Lu et al. (2021) listed enhanced intelligence of the healthcare sector; expedited accessibility and effectiveness of services; the collection of real-time vital-sign data combined with medical IoT and an AI model algorithm; the possibility of identifying early risks among patients in the NICU and CCU; providing treatment recommendations and predicting treatment outcomes; the integration of AI and IoT in emergencies for rapid and precise diagnosis and treatment, allowing timely rescue efforts and saving lives; lowering risks through early identification and timely intervention for high-risk patients with VTE; enhancing patients' quality of life; enhancing monitoring capabilities; ensuring patient safety; and enabling more accurate and efficient medical image recognition and diagnosis. This list is almost exhaustive. The empowerment of chronic patients by providing data on their health status and methods for improvement are two additional benefits mentioned by Mahmoud et al. (2020). The synthesis of various technologies is advantageous for integrating functions before, during and after an emergency alert (Basanta et al., 2016; Lakshmi et al., 2021). The flexibility of business processes (Tôn & Lê, 2019) can be added to this list. Hameed et al. (2020) stressed low-cost access for remote-area patients as a specific advantage of their patient monitoring system based on IoT and machine learning. Nurses' own perspectives reinforce these benefits while cautioning that successful adoption depends on training, workload management and ethical safeguards (Almagharbeh et al., 2025).

The challenges listed by Lu et al. (2021) are threats to information security, missing IoT data standards, risks due to speciality refinements, ethical issues and a lack of interdisciplinary medical talent. A specific challenge of heterogeneity occurs due to the diversity of objects in IoT, as noted by Xu et al. (2014). Albahri et al. (2018) listed network optimisation, disease monitoring, general healthcare services, healthcare data management, power consumption and energy efficiency, decision support systems, triage, security and privacy, disaster and emergency management, and AAL as the challenges. The specific challenges in developing countries listed by Utekar and Umale (2018) are technology, infrastructure, trained doctors and connectivity among all stakeholders. Due to rapid population growth, providing healthcare services in rural areas is becoming a challenge. Patients such as those in the ICU, at home or in distant places, who are remotely located, need continuous monitoring and support. There is also the problem of regularly updating doctors on the monitoring parameters and the history of patients.

Monitoring potential COVID-19 patients among those treated in home isolation is a challenge despite many developments in IoT-based patient monitoring systems, as was found by Albogamy (2021).

Overall, there is sufficient support from the literature for answers to the two research questions from the findings of this review. In answer to the first question, the literature provides several IoT-based nurse alert systems for implementation in different contexts. Many benefits and challenges have also been reported in the literature in answer to the second research question.

Conclusion

In conclusion, many papers report IoT-based systems that can be used for nurse alerts, and AI and machine learning are increasingly embedded in these systems for risk prediction, alert prioritisation and decision support. The benefits and challenges are well recognised, and some solutions to some challenges have been proposed. By answering the two research questions, this review has achieved its aim of identifying the various IoT-based nurse alert systems and the benefits and challenges involved in using them.

Limitations

One limitation may be the use of Google Scholar to identify papers instead of bibliographic databases. As a target of 25 papers was fixed, the search strategy matters less, but limiting the review to 25 papers might have missed important works; no paper published in 2024 could be selected, probably due to this target.

A systematic review with meta-analysis would have been preferable. Limitations of time and resources did not permit this; moreover, many papers used different types of data with different expressions that were not compatible with a meta-analysis format.

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