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INNOVATIVE TECHNOLOGIES IN THE PHARMACEUTICAL GLOBE

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Abstract - This review article deals with the numerous cutting-edge techniques and technology that could support patients in gauging their adherence to treatment. In the extremely fragmented digital health market, which includes wearable technology, telemedicine, electronic health records, and mobile health apps, there are many small and medium-sized businesses. Among other leading companies in the digital health sector are Apple, Google, Philips, Medtronic, and Roche. By using the power of digital technology to gather, analyse, store, and exchange health data, digital health aims to increase the efficiency, accessibility, and effectiveness of healthcare. Digital health includes electronic health records (EHRs), telemedicine, mobile health applications, wearable technology, the internet of medical things, and cutting-edge digital technologies.

Keywords - Google, Philips, Telemedicine, Technology

INTRODUCTION –

Smart gadgets in the pharmaceutical sector refer to electronic devices or systems that use sensors, data analysis, and connectivity to improve the efficiency, accuracy, and safety of various pharmaceutical processes. These gadgets can range from simple devices, such as smart pill bottles or smart thermometers, to more complex systems, such as wearable devices or smart labels[1]. The use of smart gadgets in the pharmaceutical sector can help to improve patient outcomes, reduce costs, and enhance safety by providing real-time feedback, monitoring patient health, and tracking environmental conditions during storage and transport of pharmaceutical products. Additionally, these devices can help to streamline pharmaceutical processes and reduce the risk of errors, such as medication errors, by providing automated reminders, alerts, and other forms of support [2].

Examples of smart gadgets in the pharmaceutical sector include smart pill bottles, smart inhalers, wearable devices, smart thermometers, and smart labels. These gadgets use sensors and connectivity to provide patients and healthcare providers with useful data and feedback to help manage chronic conditions and ensure the safe and effective use of medications [3-4].

Smart gadgets are increasingly being used in the pharmaceutical sector to improve efficiency, accuracy, and safety. Here are a few examples:

1. **Smart Pill Bottles**: These are pill bottles that use sensors to track when medications are taken and send reminders to patients if they forget to take theirmedication. This helps to ensure that patients take their medication on time and in the correct dose, which can improve medication adherence and health outcomes.[5]

2. **Smart Inhalers**: These inhalers are used to treat respiratory conditions such as asthma and COPD. They use sensors to track inhaler usage and provide feedback to patients on their inhalation technique. This can help patients to use their inhalers correctly and get the most benefit from their medication.[6]

3. **Wearable Devices:** Wearable devices such as smartwatches and fitness trackers can be used to monitor patient health and provide real-time feedback. This can be especially useful for patients with chronic conditions such as diabetes or heart disease.[7]

4. **Smart Thermometers**: These are thermometers that use Bluetooth or Wi-Fi to connect to a smartphone app, allowing patients to easily track their temperature over time. This can be useful for monitoring symptoms of a fever or other illness.[8]

5. **Smart Labels**: Smart labels are labels that use sensors to track the temperature, humidity, and other environmental conditions of pharmaceutical products during storage and transport. This can help to ensure that medications are stored and transported under the correct conditions, which is important for maintaining their efficacy and safety.[9] Overall, the use of smart gadgets in the pharmaceutical sector has the potential to improve patient outcomes, reduce costs, and enhance safety.

1)Smart watches–

Smartwatches have a wide range of potential applications in the pharmaceutical sector. Here are a few examples:

Monitoring Vital Signs: Smartwatches can be used to monitor vital signs such as heart rate, blood pressure, and respiratory rate. This data can be useful in managing chronic conditions such as hypertension, diabetes, and asthma.

Medication Reminders: Smartwatches can be programmed to remind patients to take their medication at specific times. This can help improve adherence to medication regimens and reduce the risk of medication errors.

Data Collection: Smartwatches can collect data on patient health and medication use, which can be useful for research purposes. For example, data collected from smartwatches can be used to study the effectiveness of certain medications or to identify potential side effects.

Telemedicine: Smartwatches can be used for telemedicine consultations, allowing patients to consult with healthcare providers remotely. This can be particularly useful for patients who have difficulty traveling to healthcare facilities.

Clinical Trials: Smartwatches can be used to collect data in clinical trials, providing researchers with a more detailed picture of how a medication or treatment is working. This can help to improve the accuracy of clinical trial results and reduce the time and cost associated with clinical trials.[10-13]

Overall, smartwatches have the potential to improve patient outcomes, reduce costs, and enhance the efficiency of various pharmaceutical processes. However, there are also concerns about the accuracy and reliability of smartwatch data, as well as issues related to patient privacy and data security. It is important for healthcare providers and pharmaceutical companies to carefully consider these issues when incorporating smartwatches into their practices.[14]

Fig no. 1 - Smart watches

2) Smart phones –

Smartphones have many potential benefits in the pharmaceutical sector.

Mobile Apps: Mobile apps can be used to improve medication management, monitor symptoms, and provide educational resources to patients. For example, there are apps that allow patients to track their medication use and receive reminders when it is time to take their medication.

Telemedicine: Smartphones can be used for telemedicine consultations, allowing patients to consult with healthcare providers remotely. This can be particularly useful for patients who have difficulty traveling to healthcare facilities.

Data Collection: Smartphones can be used to collect data on patient health and medication use, which can be useful for research purposes. For example, data collected from smartphones can be used to study the effectiveness of certain medications or to identify potential side effects.

Communication: Smartphones can be used to communicate with patients, healthcare providers, and other stakeholders in the pharmaceutical sector. For example, healthcare providers can use smartphones to communicate with patients about their medication regimens or to receive alerts about potential medication interactions.

Clinical Trials: Smartphones can be used to collect data in clinical trials, providing researchers with a more detailed picture of how a medication or treatment is working. This can help to improve the accuracy of clinical trial results and reduce the time and cost associated with clinical trials.

Overall, smartphones have the potential to improve patient outcomes, reduce costs, and enhance the efficiency of various pharmaceutical processes. However, there are also concerns about the accuracy and reliability of smartphone data, as well as issues related to patient privacy and data security. It is important for healthcare providers and pharmaceutical companies to carefully consider these issues when incorporating smartphones into their practices.[14-16].

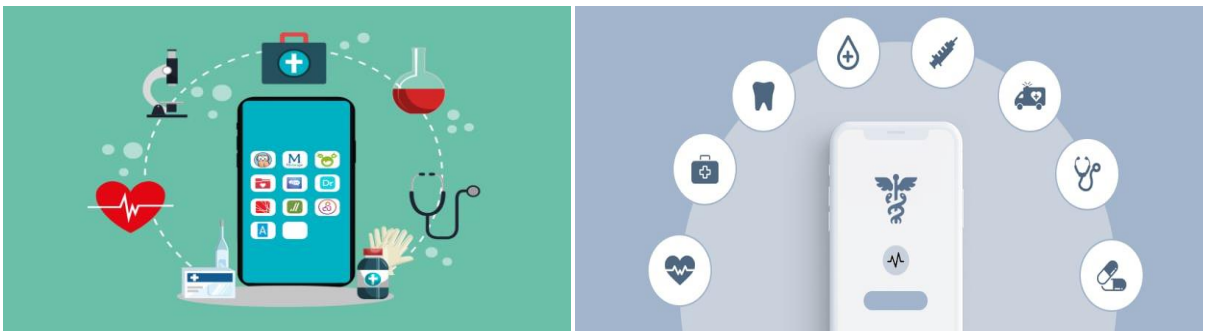

Fig no.2- Smart phone

3) Biosensors–

Biosensors are analytical devices that can detect biological or chemical analytes and convert them into measurable signals. In the pharmaceutical sector, biosensors have several potential applications, including:

Drug Discovery: Biosensors can be used to screen potential drug candidates for their efficacy and selectivity. For example, biosensors can be used to detect the binding of a drug to its target protein or to measure the activity of an enzyme that is important for drug metabolism.

Quality Control: Biosensors can be used to monitor the quality and purity of pharmaceutical products. For example, biosensors can be used to detect impurities in drug formulations or to measure the concentration of active ingredients in a medication.

Point-of-Care Testing: Biosensors can be used for point-of-care testing, allowing healthcare providers to quickly and easily diagnose diseases or monitor patient health. For example, biosensors can be used to measure blood glucose levels in patients with diabetes or to detect infectious diseases in patients.

Environmental Monitoring: Biosensors can be used to monitor environmental contaminants, such as pollutants or toxins, that may affect human health. For example, biosensors can be used to detect the presence of heavy metals in water or to measure the concentration of pesticides in agricultural products.

Biosensors have the potential to improve the efficiency, accuracy, and safety of various pharmaceutical processes. However, there are also challenges associated with the development and implementation of biosensors, such as ensuring their reliability, sensitivity, and specificity.[17-20] .

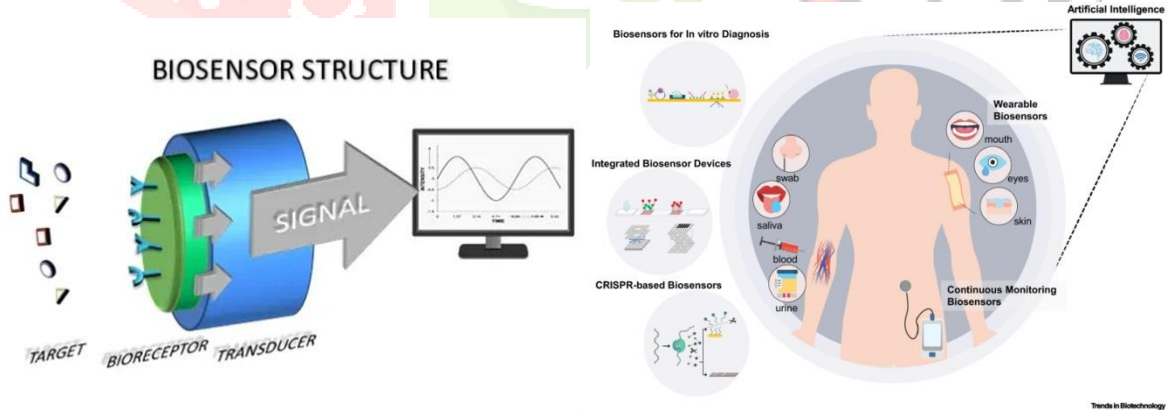

Fig no. 3 – Biosensor

4) ERP SOFTWARE –

Enterprise resource planning (ERP) software is a suite of integrated applications that help manage various business processes, including accounting, inventory management, supply chain management, and customer relationship management. In the pharmaceutical sector, ERP software can be used to streamline and optimize various operations, including:

Batch Manufacturing: ERP software can be used to manage batch manufacturing processes, including raw material procurement, production scheduling, and quality control. This helps ensure that pharmaceutical products are manufactured efficiently and consistently, with proper traceability and compliance with regulatory requirements.

Inventory Management: ERP software can be used to manage inventory levels, including raw materials, work-in-progress, and finished goods. This helps ensure that there is an adequate supply of materials and products to meet demand, while minimizing the risk of stock-outs or excess inventory.

Quality Management: ERP software can be used to manage quality control processes, including inspection, testing, and documentation. This helps ensure that pharmaceutical products meet quality standards and regulatory requirements, while minimizing the risk of defects or product recalls.

Sales and Distribution: ERP software can be used to manage sales and distribution processes, including order processing, invoicing, and customer relationship management. This helps ensure that pharmaceutical products are delivered to customers in a timely and efficient manner, with proper tracking and visibility throughout the supply chain.

ERP software can help pharmaceutical companies operate more efficiently, reduce costs, and improve compliance with regulatory requirements. However, the implementation of ERP software can also be challenging, requiring significant planning, resources, and training to ensure successful adoption and integration with existing systems,[21-24]

Fig no. 04 - ERP

5) Fitness tracker: The World Health Organisation (WHO) advises adults to engage in 150 minutes per week of moderate-intensity physical activity (PA), while children and adolescents should engage in 60 minutes .More than 80% of teenagers and 25% of adults fail to meet the suggested PA goals . Only 30.4% of women and 22.0% of men in Norway, where the Troms survey is the longest-running population survey, achieve the suggested threshold .Low PA is currently the fourth most important mortality risk factor worldwide .Wearable fitness trackers are still widely used, and new fitness gadgets keep coming onto the consumer market despite the few evidence that using them would benefit health .[25-27].

a) Sensor: Sensors A wide range of tools claim to measure PA in novel and enhanced ways. These devices calculate metrics that may be read by humans based on sensor output using a variety of sensors and algorithms. To determine daily step counts, conventional step counters employ pedometers. Pedometers are less precise than accelerometers, which are the current industry standard for gathering PA data, despite being less expensive and energy-efficient .Gyroscopes, magnetometers, barometers, and altimeters are additional features found in some wearables. By sensing gravity acceleration, also known as orientation and angular velocity, a gyroscope may improve device accuracy and enable better activity classification .[28-30].

b) Algorithms and Mobile Apps: To be useful to the user, raw sensor data must be transformed into readable metrics**.**Many devices rely on an accompanying mobile app to provide the entire range of available metrics, such as the historical daily step count and detailed HR data. Instead, they only show a small subset of metrics directly on the device (such as the current HR or step count). Each additional sensor included in a device can be used to add additional types of metrics for the user or supply internal algorithms with additional data to improve accuracy of already available metric types. However, additional sensors affect price and power consumption.[31-32].

c) Wearable Usage Scenario: In contrast to other consumer electronics, fitness trackers are unique. By characterising the body as "a repository of identifiably stored and processaIoT devices exchange a staggering quantity of data, as more than 150 zettabytes (150 trillion gigabytes) of data will be produced by 2025 ble data,The gathering, sharing, and distribution of user-generated data have increased as a result of the popularity of IoT devices, such as smart home gadgets and fitness trackers. According to estimates, the average person nowadays generates 1.5 GB of data every day. In this study, we explore whether analysing and using the information gathered by fitness trackers can yield conclusions about the owners' routines, health, or other private information.[33]

Considering the outcomes,

d) Background: This section presents research in the areas of wearable privacy protection, inference extraction from fitness tracker data, and related works in the field that collect and analyse fitness tracker users' opinions and perceptions in relation to the protection of their privacy.[34]

Fig 05 - Fitness tracker

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