JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

REVIEWX ON:-THE DIGiTAL TOOLS FOR IMPROVING MEDICATIONS ADHERANCE

Author's Name:-Pratiksha Dilip Kale.

Guide Name:-Dr.Sachin.B.Somwanshi.

Name of Institution: PRESs College of Pharmacy (for women) Chincholi, Sinner 422102 Nashik, Maharashtra, India.

Abstract:-

Especially with chronic illnesses, medication non- adherence is a common, complicated, & important. worldwide health care concern... Because of the aging populations, heart failure (HF) is a major cause of morbidity & mortality. Major health consequences, including death, may result from not taking Medication according to schedule.About 1,25,000 deaths & up to 25% of hospitalizations are expected to arise from prescription non- adherence each year, costing the American healthcare system. In order to maximize drug adherence, the patient, healthcare professionals, and the healthcare system must all work together. This chapter discusses several digital tools for enhancing medicine safety including mobile apps, smart pill bottles, smart package system, smart pill dispensers, & bio-ingestible sensors Because each technique has Specific benefits & restrictions.In this work trade-offs between accuracy, energy utilization and acceptability, user comfort, & user authentication are discussed. A Number of these digital safety supporting tools are still pricey & require compliance with regulatory requirement and widespread acceptance, despite the fact that they offer important solution to patients throughout their whole health care journey. However, There hasn't been enough research done to yet to support the use of mobile health apps to improve Medication adherence.

Keywords:-

Mobile Health Apps,Digital technology ,Medication Non-adherence, Adherance..

Introduction:-

Medication safety can be summed up at the safe & effective use of Medication. people who use pharmaceuticals are significantly affected by Adverse drug events (ADE'S), which include dosage errors & adverse drug responses (ADRs). pharmacist play a significant role in mitigating these effects & ensuring patient safety. And also medication adherence is defined by the world Health organization, "As the degree to which the person's behavior corresponds with the agreed recommendation from a health care provider, on the other hand, compliance/complaint refers to how closely a patient complies with a doctor's recommendation complaince means that the patient will submit to the doctor's authority.

Technologies for Tracking medication adherence with various types & Functionalities are constantly being developed & enhanced. It has been demonstrated that patient engagement & active support promote adherence

behavior, which has been linked to improved clinical outcomes and health related quality of life.The persistence team, which can be defined as the length of time a patient takes medication from the moment it is initiated, is another group involved in medication adherence and medication adherence behavior can be Interpreted as a combination of two principles leading to therapy discontinuation :-

- following doing medication as directed, preserving in taking it, and continuing to do so throughout the course of therapy.
- To research, comprehend, And implement digital technology in the medical sector.

What is medication Adherence systems..?

systems for managing prescription regimen and increasing patient adherence to recommend treatments are known as digital medication adherence system. These system often use wearable technology, mobile apps, or other digital tools to track and monitor medication adherence and usage.They can send notification and reminders as well as facilitate communication Between patients & medical professional. These system objective are to support patient in more successfully managing their chronic diseases and to enhance patient outcomes by lowering the likelihood of medications-related errors and consequences.

One of the most crucial elements that impacts. treatment outcomes, particularly in patient's who are suffering is drug adher -ence,from persistent illnessed or ailments whatever the drug effectiveness without the patient taking it, it cannot work.Low drug adhrence has lost significance as a result of sustantially reduces the advantages of present medical treatment & places a heavy financial burden on each patient as well as the health care system as a whole.

The term "complaince" can be used to describe patient yielding and submitting as well as authoritarian attitude on the part of health care providers. Non-compliance is the inability, or refusal to follow instructions, and might Indicate disobedience on the part of the patient. It is challenging to draw conclusions from the Fragmented research on drug adherence because there is no industry-accepted gold standard for determining adherence findings based on the completed investigations.In this difficult field, additional research is required, especially when take into consideration the numerous variables that might be regulated to enhance adherence. The need for fresh theories and ideas to help with medication adherence is great and it needs a lot of attention.etc.

Advantages and disadvantage of medication safety:-

Advantage:-

- Enhancing patient outcomes while lowering expenses of medical care.
- It is a feasible to increase drug adherence and thereby enhance clinical outcomes and patient care.
- Bettter interaction with medical professionals through the provision of real-time data on medicine intake & complaince, enabling medical professionals to track the patient's progress and alter their treatment plan, accordingly.

Disadvantage:-

- medication non adherence can result in uncontrolled chronic conditions that exacerbate existing medical illnesses, complicate treatment plans, cause dosing errors, & even result in death from overdose or failure to manage a life threatening condition.
- patient who take many medication could find that if they are administered at the wrong time, they are ineffective.
- High initial costs:- for small & medium sized healthcare proriders, maintaining a computerized drug adherence system can be costly.

Strategies to Improve medication adherence system:-

There Are various strategies that providers can use to Improve medication safety etc.

- Recognize
- Engage community pharmacist
- Follow up with patient
- Identify health literacy
- Minimize complexity
- Write it down
- Talk about side effects
- Partner with patients
- Think about the cost to the patient's

Evaluation of compliance:-

Since prevention is always preferable to treatment in this situation, preventing non-adherence is easier than detecting it.The following are the different approaches used to evaluate compliance:

(A)Direct technique

- Direct observations:-The patient is personally observed to ensure that medication are administered on schedule. Direct observation is more readily possible for in-patients, particularly in the ICU, but it is not possible for out-patients or in ordinary wards.For example, DOTS center does an assessment the of antitubercular medication.
- In vivo drug level estimation:-To estimate drug level, body fluids like blood or urine are periodically collected and analyzed using the appropriate instrumentation, methods.
- In vivo estimation:-In this method a marker Is co-administered with a medication in a tracer guantity, & the presence of the marker in the body or a body fluid is assessed.This procedure is difficult and should only be utilized in extremely rare circumstance with ethical approval for marker administration

Additionally, the technique can be used in clinical trials to track the administration of placebo.

(B) In direct techniques:-

- patient reporting:-The simplest method is for the patient to directly provide a report. Every time a patient comes to buy medication, the pharmacist should Ask them about any past treatment they may have received. The patients are asked to self-report their experiences. A local pharmacist should be able to gather information on treatment completion, Inconveniences associated with the regimen, frequency of adverse reactions,etc.
- patient interview:-A pharmacist should conduct a formal interview with patients to learn more about how well they are taking their medications. The pharmacist should have a planned, straight-forward questioner that covers characteristics. Such dose completion, ease of measuring the dose from the container, difficulty in Administering, palatability, & any other causes for a specific issue, structured adherence surveys may be used during such interviews, consider the medication safety Scale.
- patient kept Dairy:-Another option is for the patient to regularly record things in a dairy. This method of evaluating patient adherence is quantitative. The patient can be taught to utilize this technique by the pharmacist, but the patient must be motivated to support the dose given & its therapeutic outcome in terms of the reduction of signs & symptoms experienced such as nausea, diarrhea, etc. These simple methods are based on one-on-one interaction between pharmacists & patients.

These give acurate information about regimen adherence. However, these methods are more expensive & occasionally inconvenient.

Tehchnological innovations for Improving medication Adherence:-.

(1)Mobile Apps:-

Mobile Apps these days serve patients in a countless of ways to improve medication adherence.

(2)Smart pill Bottles:-

These medical adherence devices can track when patients take their medications.

(3)Smart package system:-

smart packages are the high technical version of blister or strip packging that we use in our day to day lives.

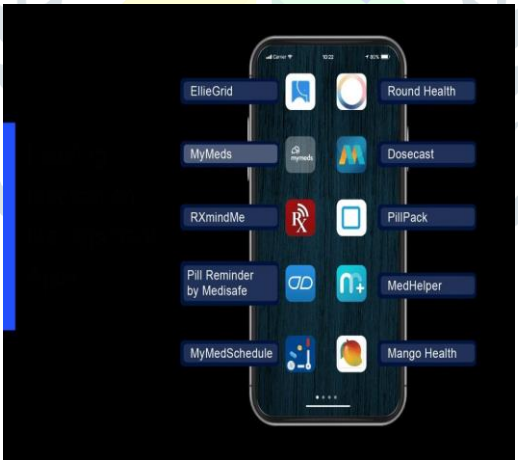
(4)Smart pill dispenser:-

This technology is an advancement of the smart package system.

(5)Bio-ingestible Sensors:-

The use of the mobile apps improved patient compliance.These advices are pill-sized electronic chips that ping your smartphone with data after you swallow them.

(1)Mobile Apps:-



The use of the mobile app improved patient compliance. When compairing self-reported adherence and missing dosage with a percentage increase ranging between 7% and 40% the before & after adherence measurements revealed substantial statistical improvement in five of them.

Mobile applications that enable users to Connect with their healthcare provider about their medication regimen, set reminders, for taking their pills, and track their medication use.

mobile apps remind patients when to take their medication and help them keep track of their health information, acting as a "digital medical centre" for users. The main primary benefit of these application is their cost, the majority of them are free, however some may gather data for commercial purposes (business reasons) many apps also employ compitition and starts to promote adherence.

Various mobile Apps used in Improving medication Adherence.

- ★ **My meds Apps:-**Sending you daily medicine & replacement of reminders (By sms, email, or push notification based on your preferences) is one way that my meds can keep you healthy. helping you in

understanding the justification for taking your medications.keeping your loved ones and medical team informed about the medication you are taking.

- ★ **Pill Reminder By medisafe:-**It enables you to make a list of your medication & set reminders for when to take each one. You can also add medical appointments to a diary, note how You are feeling, and keep track of medical tests, measurements, & outcomes using the Apps.
- ★ **Tata 1mg App:-**You can visit doctors online from your house thanks to Tata 1mg private conversation with licensed medical professional. Locate medical professionals & schedule appointments with dermatologists, gynecologists, & other Specialities.Tata 1mg doctors must go through a vigorous enrollment and verification process. etc.

(2)Smart pill bottles:-

Utilizing technology-based solutions, such as Smart pill bottles, to track medication Adherence is one efficient monitoring stategy.Smart pill bottles are discrete & accurate compared to other technology-based alternatives. since they can be equipped with a set of sensors.

These gadgets can the weight of the remaining pills in the container, or sensors in the cap that detect when a bottle is opened to identify when a patient takes their medication.Smart bottles can be added to a patient's existing foundation & can be used without an app or other piece of technology.

Although these devices can measure when a pill is disappears, they cannot track if the medication was actually consumed, therefore the cost of these bottles can quickly pile up for patients who take many medication. *•* one study found that patients who used smart pill bottles had higher self-reported adherence, but there was no corresponding improvement in therapeutic doses.

Function:-

It will automatically keeps track of when the bottle is opened, and if a dose is scheduled, marks it as "taken".As well as Setting up "take as needed" medication, the app allows you to view your whole medical history.etc

(3)Smart package system:-

The smart packaging solution, tracks the temprature inside the bottle, allows for the indication of taken doses, and can remind or warn patients as necessary to encourage adherance, etc.

Smart package devices are high-tech variation of blicter & strip packaging that function as reminders for patients & track does that have been administered. smart package system can be integrated with prescriptions packaged by a pharmacy & are especially helpful for people taking multiple medication, etc.

Smart package systems have the potential to be used as a "onestop" device, but because they are larger, they can be highly expensive. They can only track if a pill was withdrawn, not if it was taken, just like with smart pill bottles.

In a study, patients who were given smart pill trays & health coach counseling experienced higher levels of adherence, but there was no difference in drug concentration. It was also not clear whether the higher levels of adherence were brought on by using the devices or by the health involvement

(4)Smart pill dispensers:-

The smart pill dispenser is an autonomous/automatic pharmaceutical dispensers that, at the push of a button, organizes, plans, & disperses patient medication.

This devices, which Dr. Aungst facetiously referred to as the "offspring of the previous technology & Amazon's Alexa," integrate/ combine voice assistants for the house, remote access to medical specialists & other activation capabilities while administering medication.

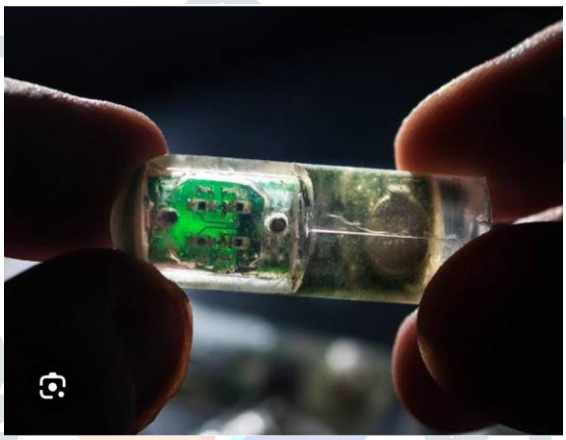
Smart pill dispensers can be quite expensive, but they can also as able to fit a range of patient needs. This is similar to smart package system. The fracking of perfect adherence by these devices is equally challenging.

Working:-

The dispenser involves the use of an ultrasonic sensor depending on which the dispenser dispenses pills to the patient. The sensor is active user for a certain period of time after the alert message has been sent to the user.

The main goal of automatic medication, dispenser is to simplify medication management.There is a far lower likehood of forgetting a dose when medication Reminders and dispensing are automated. Hero's automatic pill dispensers is very Simple to set up etc.

(5)Bio-ingestible sensors:-



Ingestible sensors have been created to measure physical variables like pressure and Core temperature. Although the topic is still relatively young & has a bright future, there are chemical & biological elements, are related to the function and balances in the gut.

Working:-

To capitalize on the distance factor and its impact on the power of the electromagnetic coil, the researchers created a Sensor that could fit inside a Swallowable capsule. The sensor measures the magnetic field around it to determine how far away the coil outside the body is.

These gadgets are implanted into an oral pill that, upon dissolving, sends a notification to a patient's smartphone, and later to a doctor via a wearable patch informing them that they have taken their medication. Ability mygate, the first medication with a bioingestible sensor to earn

FDA approval, etc. Bio-indigestible sensors were able to monitor adherence, but they do not directly increase it. The typical cost to consumers of these devices is still unknown because of their novelty.

Although, Dr Aungst underlined that much more effort & creativity are required to make that potential a reality, he said that digital technology could prove to be a crucial adherence and gathering objective, real time data.

Digital health represents a novel means of assessing & potentially improving medication adherence through multiple oriented interventions," he said. in his conclusion. However, the present focus on a "all-in-one" solution platform has not yet shown encouraging clinical results.etc.

Medication Non-Adherence System:-

When someone does not take their prescription drug Are prescribed by their healthcare professional, this is referred to as medication non-adherence. Non-adherence can have negative impacts on a person's health since it could result in poor therapy, the advancement of a disease, or There are several reason why someone might not follow the prescribed regimen, including forgetfullness, worries about adverse effect, the cost of the prescription, or a lack of understanding of its significance. If someone is having trouble following to their treatment plan, it's important for them to be in advance about it with their healthcare professionals in order to identify answers or, if required alternate treatments.

Causes of Medication Non-adherence:-

Medication non- adherence has various frequent causes, including:-

- Forgetfulness is one of the most frequent causes of non-adherence is forgetting to take prescription.
- complex schedules managing complicated dosing schedule or a lot drugs can be challenging.
- Side effect:- patient who have unfavorable side effects from some medication may stop taking them altogether or reduce their dosage without first talking to their doctor.
- The cost of prescription:-Due to Financial limitation, some people may find it challenging to pay for their prescribed medication.

Pharmacist role in the medication Adherence:-

Pharmacist play a crucial role in medication adherence. They are often the last health care professionals patients interact with before starting a new Medication a prescription.

Pharmacist can improve medication adherence, in a no of ways including:-

- Educating patients:-Pharmacist can inform patients on how to take their medication, how they function, and What adverse effects to expect. Additionally they can assist patient in understanding the importance of taking their prescription as directed & how doing so will benefit them.
- Simplifying medication schedule:-It can be made possible with the help of pharmacists, who can work with patients on this. In order to do this, people may need to take fewer pills, take their medicine at the same time every day or combine certain medications.
- Handling side effects:-Pharmacist can assist patients in managing drug side effects. To do this, it may be necessary to suggest over the counter drug, alter the dosage or administration schedule.
- Providing support:-patient get the assistance they need from pharmacist to take their prescription as directed. This may involve reminding patients to take their medication, offering therapy, or linking them with other resources.

Conclusion:-

Certainly. Digital solution have demonstrated a great deal of promise for enhancing drug adherence. The patient's journey through healthcare is changing as a result of the use of digital adherence tools like m-health apps, smart pills, smart packages, and dispensers.These tools can be used for appointments, consultations, decision-making integration, tailored regimens, medication dispensing, monitoring, and even learning about routine medication management. These apps give users the power to more effectively manage their prescription schedules with features like reminders, notification, and tracking Interactive interfaces and instructive content also improve comprehension and motivation.Mobile Application and wearable technology's convenience and accessibility also contribute to successful outcomes. But it is important to take into account elements like user

engagement, privacy issues, and accessibility for various demographics. Mobile Application & wearable technology's accessibility & ease are Crucial for encouraging constant adherence. It is clear that these developments have huge potential to transform drug management and ultimately improve patient outcomes as the digital technology continues to change.

References:-

1.S Setya, M F Singh. S Talegaonkar.Digital Technology for improving Medication Adherence Bull. Env. Pharmacol, Life Sci, Spl Issue[4]:2022:230-238.

2.Murtadha Aldeer, mehdi Javanmard and Richard.P. martin (6-May 2018) A Review of medication Adherence monitoring Technologies, https://doi.org/10.3390/asi1020014

3.A Text Book of clinical pharmacy practice - 2nd edition Parthasarathi: NY Fort - hansen: Nahatta

4. Ramesh Ganpisetti, Apr 10, 2018 By slideshare ascribd Company (medication. Adherence.)

5.Claudine Backers, carla moyano, Camille Rim and, christine Bienvenu, Marie P.Schenider. Digital medication Adherence support: Could Healthcare providers. Recommend miHealth Apps &. 2021-Feb-17.10 3389/fmedt 2020 616242.

6. Job F.M.Van Boren of Joao A Fonseca, 27 Sep 2021. Digital Took to measure & promote medication" Adherence, doi: 10.3389/Fmedt 2021.751976

7. Nasser Al-Jawad & Zahraa Jalal, 29-June-2023, The use of Technology to improve medication adherence in HF Patient.

8. Jehath syed, Digital medication adherence systems: The Technology-driven future of Healthcare, 18-Jan 2023,

9. Madilyn mason, Yang Gong, Yun Jiang (24-Nov, 2021, Technologies for medication Adherence monitoring. & Technology Assessment Criteria: N. https://prepoints.Jmir org/ preprint/35157

10. Susanne & Haga, 22-May-2020, Toward Digital-based interventions for medication adherence & safety..

https://dot.org/10.1080/14740338.2020.1764935

11. Aungust T.from pill boxes to smart Pills How Digital. Health is changing medication Adherence, presented At:. 2018 ASHP Midyear clinical meeting. Dec 2-2018, el

12. Ryan marotta Dec-5,2018, Five Digital Tools for Improving medication Adherence

13. Jason.Z. Rose MHSA Charting a New path to At Home medication Adherence with Digital pharmary Support Jul-17-2022

14.Daniel.V.O'Hara, Tae Won Yi, Vincent w Lee, Jessica Dawson Digital Health technologies to support mediation. Adherence in chronic kidney disease 29-Sep-2022

H/https://doi.org/10.1111/nep.14113.

15. Noha Awed Alharb, yahya Abdu. Alkhawaji, 9-3-23, Use and effectivness of Digital Adherence Tools, Saudi Imed pharm Sci 9 (3)155-162.

16.Tzipora.Lieder.Rph-Ten Strategies to reduce medication errors, April 10,2020

17.Robert Langer ORCID: orcid.Org/0000-0003-4255-0492.Overcoming barriers to patient adherence The case for Developing innovative drug delivery system.27-March-23.

18.Linda.G.Park, ofelia villero Perception and experiences of using mobile technology for medication adherence among older adults with coronary Heart disease: A qualitative study.May- 20.2020

19.Don Roosa Jay Chok, Andrius Baskey.9-11-2020 in Vol 9.No 11(2020)Nov Artificial intelligence- powered smartphone App to Facilitate medication adherence: Protocol for a human factor design study.

20.Bruce Gould How Digital Tools can improve medication adherence in clinical Trails, Aug28,2019.

21. Washington Marriott,Medication adherence: Landscape,strategies and evaluation methods 775 12th St. NW.Dec. 10,2019.

22.Marina Rovira-Illamola maite martin conde, 4-April-2016,mHealth intervention to improve medication management in chronically ill patients Analysis of the recruitment process.http://dx.doi.org/10.1080/00325481.2016.1170580

23. Prejith Philip Chacko Medication adherence, slideshare .March 29,2019.

24. World Health Organization (2023).Adherence to long term therapies evidence

action/[edited By Edurdo S.

25.https://allazohealth.com studies of Smart pill bottles maximize medication of compliance.

26. Anghel LA, Farcas AM, Oprean RN. An overview of the common methods used to measure treatment adherence.Med Pharm Rep. 2019 Apr:92(2):117-122 3.

27. Becker E, Metsis V. Arora R. Vinjumur J. Xu YR, Makedon E. Smart Drawer: RFID-based smart medicine drawer for assistive environments Proceed IntConfPErvasive TechnolRelat Assist Environ, 2009;49:1-8

28. Brennan V. Mulvey C, Greene G, Hale EM. Costello RW. A Clinical Perspective on the Role of Electronic Devices in Monitoring and Promoting Adherence in Airways Disease. Front Med Technol. 2021 Apr 12:3:604475 5.

29. C. Joseph & Mathews. Kelly &Sredzinski, Eric. (2019). Effect of a Smart Pill Bottle and Pharmacist Intervention an Medication Adherence in Patients with Multiple Myeloma New to Lenalidomide Therapy. Journal of managed care & specialty pharmacy. 25. 1244-1254. 10.18553/jmcp 2019.25.11.1244.

30. Available: https://www.airduodigihaler.com

31. Available: https://elliegrid.com

32. Available: https://www.wisepill.com/evrimed

33. Available: https://www.companionmedical.com/inpen

34. Haberer J. Medication event monitoring systems, In: Gellman MD, ed. Encyclopedia of Behavioral Medicine.Cham: Springer, 2020,

35. Hugtenburg JG, Timmers I, Elders PJ. Vervloet M, van Dijk I. Definitions, variants, and causes of nonadherence with medication: a challenge for tailored interventions. Patient Prefer Adherence. 2013 Jul 10:7:675-82.

36. Kane, J.M. Comments on AbilifyMyCite. Clin. Schizophr. Relat. Psychoses 2018, 11. 205- 206.

37. Kini V. Ho PM. Interventions to Improve Medication Adherence: A Review. JAMA

2018:320123):2461-2473doi:10.1001/jama.2018.19271

38. Kopelowicz, A.; Baker, R.A.; Zhao, C.; Brewer, C.; Lawson, E; Peters Strickland, T. A multicenter, open-label,pilot study evaluating the functionality of an integrated call center for a digital medicine system tooptimize monitoring of adherence to oral aripiprazole in adult patients with serious mental illness. Neuropsychiatr. Dis Treat. 2017, 13, 2641-2651.

39. Available: https://adheretech.com/

40. Available: https://mantadesign.com/work-pill-dispenser/