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PICTOGRAM-BASED INTERVENTIONS TO REDUCE MEDICATION ERRORS: A SYSTEMATIC REVIEW

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ABSTRACT

Pharmaceutical care necessitates a patient-centered approach, emphasizing patients' capacity to comprehend drug-related information and adhere to directions given by pharmacists and other medical professionals in the circle of care. Health-care professionals must take into account a variety of risk factors, including geography (culture), social economic status, age, and low literacy, which may predispose patients to non-adherence. Additionally, chronic patients with lifelong disease states must be taken into account in order to ensure the prescribed use of medications, or medication adherence. This review's objective is to present a fair and thorough analysis of various medication counseling and education strategies that have been employed in an effort to enhance medication adherence and health outcomes through the use of succinct and understandable graphic representations, or pictograms. The current review describes the need for health-care providers to go beyond the conventional didactic methods of oral and verbal communication with patients regarding medication-taking behavior by highlighting the current landscape of the general use and efficacy of pharmaceutical pictograms to aid in the knowledge and recall of drug-related

information as well as outlining specific medication adherence outcomes with pharmaceutical pictograms in chronic patients.

KEYWORDS: Medication Errors, Pictograms, Patient Safety, Prescribing Errors, Error Prevention.

INTRODUCTION

Pharmaceutical care is a patient-centered approach that places a strong emphasis on individuals understanding drug-related information and following medical professionals' directions. According to Hepler and Strand *et al*., it seeks to improve patient well-being and quality of life by achieving particular drug-related outcomes, such as disease cure, symptom alleviation, disease progression halt, or disease prevention. In order to develop and carry out treatment regimens, pharmacists, patients, doctors, and other medical professionals must work together. Medication adherence, which has a major impact on health outcomes, is essential to this strategy, and patient literacy is crucial to getting good outcomes.[1]

Negative patient outcomes are a result of poor literacy and health literacy, which pose serious global health concerns. 47% of individuals in the United States have trouble understanding health-related information; this percentage is 60% in Canada and roughly 47.6% throughout Europe, with rates differing greatly by nation (e.g., 28.7% in the Netherlands to 62.1% in Bulgaria). According to data from Africa, over one-third of the population was illiterate in 2015, with a literacy rate of 63%. In general, both developed and developing countries are experiencing a health literacy crisis that calls for better knowledge and comprehension to improve patient medication management.[2,3]

Individuals with inadequate health literacy and chronic illnesses are more likely to experience worse health outcomes, a lower quality of life, and more healthcare costs. In addition to impeding treatment adherence in hypertension, poor health literacy is associated with higher mortality rates in heart failure patients, which might result in hospitalization and additional expenses. Low health literacy is associated with poor glycemic control and complications in diabetes. Reduced respiratory-specific quality of life, increased use of emergency services, and increased disease severity are all linked to lower health literacy in individuals with chronic obstructive lung disease. A topic of continuous discussion is indicated by certain studies that point to a lesser relationship between literacy and adherence.[4-6]

An estimated 35 million fatalities worldwide in 2005 were attributed to chronic diseases, accounting for more than 60% of all deaths. Chronic diseases affect almost 50% of all adults and 8% of children. Many adults have numerous disorders that require lifetime medication. The management of chronic diseases, which the WHO defines as the alignment of a patient's behaviors with recommendations from healthcare providers, is severely hampered by poor drug adherence.[7] The start, execution, and continuation of recommended therapies are all included in medication adherence. Non-adherence rates vary from 25% to 50%, and they are especially high in less developed areas. This can have serious negative effects on health, including a higher chance of hospitalization—more than 100% for illnesses like diabetes and hypertension. About 50% of people with chronic illnesses do not take their medications as prescribed, and up to 80% of patients with conditions like hypertension do not take their medications as prescribed. This is frequently because drug regimens are complicated. Patients must be able to read prescription labels, follow directions, and calculate dosages. In order to address medication-related concerns and guarantee effective communication that is adapted to patients' health literacy levels, healthcare practitioners must take a proactive role.[8]

MEDICATION ADHERENCE: PRESENT SITUATION

According to the WHO, the considerable research on medication adherence—highlighted by more than 200 systematic reviews—identifies factors that contribute to non-adherence, including low health literacy, costs, fear of side effects, and lack of social support. Nieuwlaat *et al.* found randomized controlled trials (RCTs) with low bias in a Cochrane review, pointing out that therapies usually included sophisticated support mechanisms from medical professionals, such as counseling and teaching.[9] However, adherence and clinical results only slightly improved as a result of these efforts. In studying medication adherence, it is crucial to define how this outcome is measured. A review by Anderson *et al.* identified 25 systematic reviews, revealing that 96% did not restrict adherence measurement methods. Main outcomes included electronic monitoring (84%), fill count (84%), patient self-report (84%), pharmacy refill data (68%), and patient blood levels (8%).[10] The most effective measures for improving adherence were dose simplification (5 reviews), electronic reminders (4 reviews), and patient education (4 reviews). Results show that medication adherence initiatives work best when they simplify dosage and offer customized support, especially when they are led by medical experts such as pharmacists. The ways in which pictograms can improve drug adherence, particularly for chronic patients, will be discussed in the sections that follow.

PICOTGRAMS

Pictograms are essentially graphical symbols with meanings that are shaped by semiotic theory, which makes a distinction between the signifier and the signified. Pictograms can be interpreted differently in different cultures. Pictograms that are well-designed must be simple and successfully convey their intended meanings to a variety of audiences, including people who are illiterate or visually impaired. Their strength is their capacity to elicit verbal memory, which makes good comprehension require clarity and an action-oriented mindset. Furthermore, since prior counseling increases the efficacy of pictograms, their integration with traditional patient education is essential.[11,12]

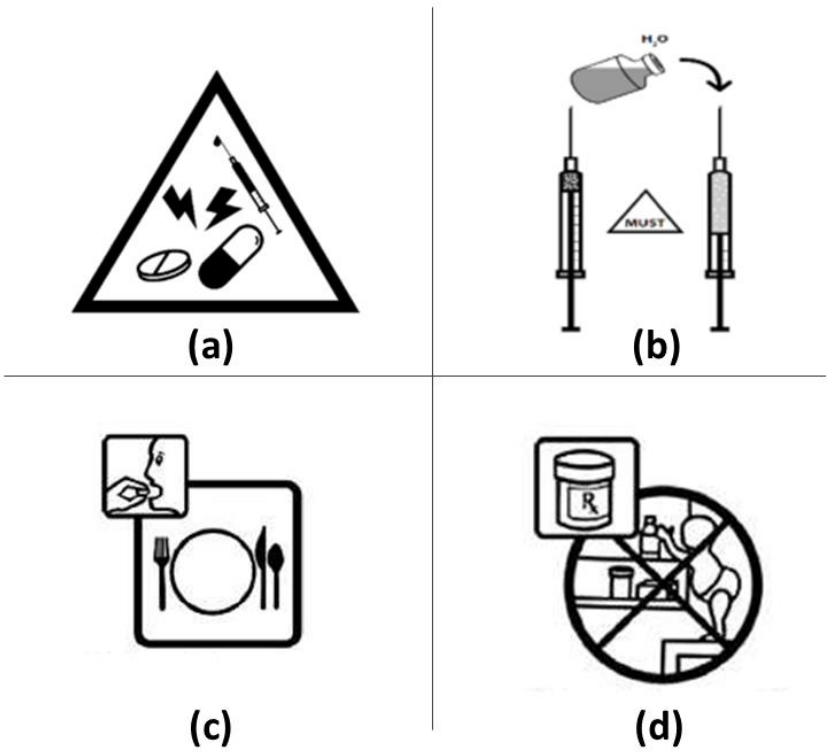

Fig. 1: Few Pictograms Examples (a) Highly Potent (b) Rinse and Use (c) Take along with Meals (d) Keep out of reach of Children.

PICTOGRAMS IN HEALTH-RELATED RESEARCH

It has been observed that over two-thirds of physicians provide written education materials for chronic patients, yet a significant portion of verbal information is quickly forgotten during consultations. There exists a notable gap in health literacy, with most health literature being at a reading level above the eighth grade. Evidence suggests that pictograms enhance the attractiveness of patient information and improve comprehension and recall of medication

behavior. However, data on the effectiveness of pictograms is limited and mixed; while some studies indicate no impact among literate caregivers, others show benefits for both low and high literacy caregivers.[13,14] There is limited information on pictograms' effectiveness for medication adherence in chronic patients, primarily in those with HIV/AIDS. While studies indicate positive outcomes for improving recall and comprehension of dosing instructions, a systematic review by Chan *et al.* highlighted that these studies have a high risk of bias.[15]

There are several key themes highlighted in interventions using pictograms, including their effects on medication safety, patient awareness, treatment outcomes, involvement in therapy, and trust in healthcare communication. A systematic review by Nguyen *et al.* identified 43 validated self-report adherence scales, emphasizing the importance of the assessment tools used for adherence outcomes and the quality of the pictograms.[16] No single measure can fully capture all behaviours related to medication adherence affecting patient outcomes. Combining multiple adherence measures can leverage the strengths of different methods to more accurately assess adherence levels.

Research indicates that patients with chronic illness and low health literacy benefit more from pictogram interventions compared to those with high health literacy, who show limited benefit. Studies shows various diseases including asthma (2 studies), diabetes (4), AIDS (7), chronic kidney disease (1), and cardiac disorders (4), as well as additional analyses focusing on elderly patients (3 studies) and self-efficacy (2 studies). Overall, pictograms have been linked to improved disease self-management among chronically ill patients, although not all interventions are effective, with some studies reporting no significant impact on medication adherence.[17-21]

PICTOGRAM DESIGN AND EVALUATION

Before performing comprehensive research studies, pictograms' efficacy in improving medication adherence must be verified against particular design standards. Pictograms are helpful for communicating drug information in healthcare and humanitarian contexts. Researchers who study health-related pictograms stress how crucial a thorough design approach is. This entails methodically evaluating pictures according to transparency (guessability of meaning) and translucency (agreeability of intended meaning), both of which enhance the pictogram's overall comprehensibility. Face-to-face procedures may also be used in the evaluation. Additionally, throughout the early stages of testing and design, it is critical to comprehend variations in patient groups, including educational attainment, attitudes, and

beliefs. Research reveals notable differences in visual interpretation within and between nations, which affects how well pictograms are used for communication. Involving the target population at every stage of the design process is crucial to get accurate and trustworthy data when assessing pictogram designs.[22-24]

Additionally, there are a number of other crucial factors to take into account to guarantee that best practices in pictogram design are adhered to in order to be able to systematically evaluate variations in study outcomes in the field of health-related pictogram research. These are guidelines that should assist teams conducting health-related research in creating excellent pictograms with the best possible visibility and intelligibility. In order to ensure that we can separate the independent effects of pictograms on medicine adherence, Sletvold *et al.* stated that research evaluating the utility of pharmaceutical pictograms must develop best practices in the design and use of pictograms.[25]

The active participation of healthcare experts in the design and evaluation procedures is crucial to the successful evaluation of pictograms for health information. Pharmacists must teach patients how to interpret pharmaceutical pictograms, for example, even though they can help with drug adherence. This is a work that should be considered a worthwhile use of time and resources. Pharmacist involvement in the development or execution of these interventions is frequently not documented, despite substantial research on pictograms in health communication, especially with reference to medication adherence. According to a systematic review by Wilhelmsen & Eriksson *et al.*, treatments led by nurses and pharmacists provide higher adherence outcomes than those led by general practitioners, highlighting the necessity of accurate documentation in next studies.[26] Researchers can carry out randomized controlled trials (RCTs) to determine the influence of pharmaceutical pictograms on medication adherence if efficient design techniques have been established. However, significant variety in current research designs and procedures is revealed by Anderson *et al.* comprehensive overview of systematic reviews, requiring an emphasis on preserving design fidelity to improve data repeatability.[10] Sletvold *et al.* agree, arguing that thorough meta-analysis of pictograms' effects is hampered by the current diversity in RCT methodology.[25]

Table 1: Summary of Some Studies Related to Pictograms and Medication Errors.

Study Ref.	Design	N	Population	Interventions	Control	Result
Dowse and Ehlers 2005[27]	RCT	87	Individuals taking short-term antibacterial drugs	Pictograms on label	Text-only label	Adherence was significantly ($p < 0.01$) higher in the intervention group (89.6%) than in the control group (71.5%).
Mansoor And Dowse 2006[28]	RCT	127	Low health literacy patients on ARVT	I1) PIL including pictograms I2) PIL without pictograms	Usual care (no PIL	In comparison to the I2 and control groups, the I1 group had significantly ($p < 0.05$) better adherence as measured by pill count and questionnaire.
Murray et. al. 2007[29]	RCT	314	Heart failure patients	Written medication information and medication labels that contained pictograms	Usual care	Significant effect on overall adherence (% of prescribed medication taken) between intervention and control group.
Yin et al. 2008[30]	RCT	245	Parents or guardians of children taking liquid drugs between the ages of 30 days and 8 years	Medication counseling includes teach-back, pictograms (HELPix), and plain language medication information leaflets.	Usual care	The intervention group had significantly ($p < 0.05$) higher adherence (9.3% non-adherent) than the control group (38%).
Zerafa et al. 2011[31]	RCT	86	Cardiac surgery patients on medications	Pharmacist intervention that includes printed medication information sheets with pictograms and medication counselling.	Usual care	Significantly ($p < 0.001$) higher compliance in the intervention group (88.2 %) compared to the control group (66.4 %)
Chan and Hassali 2014[32]	RCT	126	Patients on antihypertensive and antidiabetic medications	I1) Medication labels using enlarged fonts I2) Medication labels incorporating pictograms	Regular-size text Medication labels without pictograms	No significant effects on adherence between study groups

RCT - Randomised Controlled Trial;
ARVT - Antiretroviral Therapy;
I1 - intervention in study arm one;
I2 - intervention in study arm two;
PIL - Patient Information Leaflet.

CONCLUSION

Patients' treatment outcomes, especially those with low health literacy, can be improved by effective verbal and written communication combined with health-related pictograms. Interventions like "teach back" and Ask Me 3^{TM} can help chronic patients, who frequently have complicated prescription schedules. However, there is little research on how pictograms affect medication adherence in chronic populations, therefore for stronger results, optimal practices in their design and evaluation must be followed. In order to increase medicine adherence through the efficient use of pictograms, future research should concentrate on dose simplicity and electronic reminders.

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