Evaluation and validation of pictographic medication instructions in a tertiary hospital in Southwest Nigeria

Oluwagbenga O. Odunfa[1], Felix T. Ajayi[2], Régis Vaillancourt[3], Annie Pouliot[4], Adekunle Adediran[5] and Tajudeen A. Lawal[6]

[1] Drug Information Service Unit [2]Pharmaceutical Services; Federal Medical Centre, Bisi Onabanjo Way, Idiaba, Abeokuta. PMB 1031, Shapon P. O, Abeokuta

[3] Director of Pharmacy, [4] Project Coordinator- Pharmacy; Children Hospital of Eastern Ontario, Ottawa, Canada 401 Smyth Road, Ottawa, ON, Canada, K1H8L1

[5]Paediatric Nephrology Unit [6]Dispensary Unit ; Federal Medical Centre, Bisi Onabanjo Way, Idiaba, Abeokuta. PMB 1031, Shapon P.O, Abeokuta

Corresponding author: Oluwagbenga O. Odunfa
Email: godunfa111@gmail.com; Phone :+2348037126511

ABSTRACT

Background: Written medication instructions are often complex for individuals with low literacy level to comprehend. There is a need to improve communication between providers and patients. Pictograms have the ability to simplify medication instructions to improve medication safety, compliance, and overall health outcomes.

Objectives: The study aimed to validate and evaluate a set of pictograms from the International Pharmaceutical Federation (FIP) intended to depict medication information.

Methods: Pictogram comprehension was assessed using a "guessability" test. Translucency test was also administered to numerically assess the degree to which participants associated an image to its intended meaning. Participants were made to undergo a "REALM" (Rapid Estimate of Adult Literacy in Medicine) test to identify their level of health literacy. Guessability was then re-assessed. Data analysis was carried out using averages, percentages, Chi Square test, correlational and regression statistics.

Results: Forty (40) volunteers participated in the study. Mean guessability score was 84.5 ± 13.7% initially which rose to 96.3 ± 5.4% on recall of pictographic instructions. The mean translucency score was 6.12 ± 0.72. Males and adults had a non-significant higher odd ratios compared to females and teens respectively as regards guessability scores {1.09 (0.28-4.26, P = 0.89); 2.14 (0.38-12.03, P = 0.39)}respectively. Pictograms were better recognized and interpreted correctly by volunteers on verbal supplementation of the instructions, P = 0.000.

Conclusion: The guessability score, though below the set threshold (≥85%) initially however rose beyond it on recall test. This presupposes that the pictograms will be potentially an ideal, valid and easily understood tool to be used for explaining medication instructions if only those instructions were verbalized.

Keywords: Pictograms; Guessability; Translucency; REALM test; Health literacy

Évaluation et validation des instructions de médication pictographique dans un hôpital tertiaire au sud-ouest du Nigeria

Auteur correspondant: Oluwagbenga O. Odunfa
Email: godunfa111@gmail.com; Téléphone : +2348037126511

RESUME

Contexte: Les instructions écrites de médicaments sont souvent complexes pour les personnes ayant un niveau d'alphabétisation faible pour comprendre. Il est nécessaire d'améliorer la communication entre les fournisseurs et les patients. Les pictogrammes ont la possibilité de simplifier les instructions de médicaments pour améliorer la sécurité des médicaments, la conformité et les résultats globaux de la santé.

Objectifs: L'étude visait à valider et évaluer un ensemble de pictogrammes de la Fédération Internationale des Pharmaciens (FIP) destinés à représenter l'information de médicaments.

Méthodes: La compréhension des pictogrammes a été évaluée en utilisant un test de "possibilité de deviner". Un test de translucidité a également été administré pour évaluer numériquement le degré auquel les participants ont associé une image à son sens voulu. Les participants ont subi un test "REALM" (Estimation rapide de l'alphabétisation des adultes en médecine) pour identifier leur niveau d'alphabétisation en santé. La 'possibilité de deviner' a ensuite été réévaluée. L'analyse des données a été réalisée à l'aide des moyennes, des pourcentages, test du chi carré, des statistiques corrélationnelles et de régression

Résultats: Quarante (40) volontaires ont participé à l'étude. La note moyenne de possibilité de deviner était de 84,5 ± 13,7% initialement, qui est passé à 96,3 ± 5,4% sur le rappel des instructions pictographiques. La note moyenne de translucidité était 6,12 ± 0,72. Les hommes et les adultes avaient un rapport de cotes légèrement élevé par rapport aux femmes et aux adolescents, respectivement en ce qui concerne les notes de 'possibilité de deviner' {1,09 (0,28-4,26, p = 0,89); 2,14 (0,38 à 12,03; P = 0,39)}, respectivement. Les pictogrammes étaient mieux reconnus et interprétés correctement par des bénévoles sur la supplémentation orale des instructions, P = 0,000.

Conclusion: Le score de 'possibilité de deviner', bien qu'en dessous du seuil fixé (≥85%) initialement a toutefois augmenté au-delà sur le test de rappel. Cela suppose que les pictogrammes sont potentiellement un outil idéal, valable et facile à comprendre pour être utilisé pour expliquer les instructions de médicaments si seulement ces instructions étaient verbalisées.

Mots-clés: Pictogrammes; possibilité de deviner; translucidité; test REALM; L'alphabétisation en santé

INTRODUCTION

Health literacy is defined as a person's capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions[1] and is most often measured by adequate comprehension of health-related information.[2] Health literacy is influenced by the interaction between a person's knowledge, skills, experience and beliefs and his/her health context.[3] Various studies have demonstrated that health literacy is vital for treatment adherence and that low health literacy is commonly associated with poor patient outcomes.[4,5] Low health literacy may limit a person's ability to comprehend written or verbal health information and successfully adhere to medical recommendations.[6] Health literacy is essential to taking control of and managing one's health.[1]

Previous studies indicate that limited patient literacy is a barrier to effective medical diagnosis and treatment since they have less understanding about their medical conditions and treatment.[7] According to the global literacy rate report of the United Nations (2013) the adult (15 years and older) literacy rate in Nigeria is 61.8%.[8] In addition to the widespread illiteracy, lack of attention to health literacy issues has been shown to lead to further medical issues, resulting in high cost on the healthcare system.[9] Therefore, finding ways to improve health literacy is a public health concern. Pictograms have been found to simplify medication instructions and consequently improve medication safety, compliance, and health outcomes.[10] Humans also have a cognitive preference for picture-based rather than text-based information.[11] Pictograms contribute positively to both understanding of instructions and adherence to treatment[12] especially when they show relationships among ideas or spatial relationships.[13] Linking written or spoken text to pictures can significantly increase attention to and recall of medication instructions[10] and health education information. In addition, pictorial aids have been reported to improve patients' satisfaction with medication instructions.[11] A picture is worth a thousand words and thus, the use of pictorial aids enhances understanding of how medications should be taken and also improves adherence to instructions, particularly when such are used in combination with written or oral instructions.[11]

This research aims to evaluate a series of pictograms used to explain the labels or instructions on medications. The pictograms were evaluated based on comprehension of the series of images through guessability (transparency) and translucency scores, as well as short-term recall.

The study also aimed to determine the proportion of people who correctly guessed the meaning of the pictures; and how well did the pictures convey what they were supposed to.

These objectives were accomplished through a transparency test for the first question, and a translucency test for the second; the pictograms were further validated through short-term recall and finally a semiotic exploration of the chosen pictograms followed as steps to improve the pictorial representations.

METHODS

Design

The study was conducted through one-to-one structured interviews, using a questionnaire-based survey. A total of 26 pictographs were chosen from the International Federation of Pharmacists (FIP) Pictograms[14-16] and considering commonly encountered disease condition in the community. Two different concepts were examined in order to determine the pictograms' comprehension: transparency and translucency. "Transparency" represents the "guessability" of the picture's meaning[11] while "translucency" refers to the degree to which participants believed that the image represented their intended meanings after being told their real meanings.[17]

Demographic data were collected which included: age, gender, race, Nationality, State of origin, and highest level of schooling achieved.

Transparency: Participants were asked to describe what they thought the pictograms (Appendix A) meant. The entire set, took the participant approximately 15-25 minutes to verbally describe what each pictogram was meant to portray in the context of medication instruction. The answers were immediately recorded verbatim and later scored as being correct, incorrect or partially correct by three independent evaluators, based on the images' actual meaning. For each pictogram, the answers were scored as "correct" when the key message and interpretation of pictures were accurate and all three independent evaluators agreed. Responses were "partially correct" when the key message was correct but the image interpretation was not accurate and two out of the three evaluators agreed. Responses were classified as "incorrect" when the key message and the interpretation were all guessed incorrectly.

Translucency: After recording guessability responses, the participants were informed about the intended meaning of the pictogram and asked to repeat the meaning back. Participants were then asked to score each pictogram on a visual analog scale of 1 to 7 in rating how well the image represented its meaning. A rating of 1 indicated that there was no relationship between the pictogram and its meaning, whereas, a rating of 7 indicated a very strong relationship. A score between 2 to 6 indicated there were some relationship between the image and its meaning. In this study, a translucency score of greater than 5 was the accepted minimum score.[18]

Short Term Recall: Following the translucency test, participants were asked to complete the REALM (Rapid Estimate of Adult Literacy in Medicine) test to assess health literacy and also to provide demographic information about themselves (which took 10 minutes) to serve as a distractor before performing short-term recall. After this information was collected, the participants were again asked to describe what they believed each pictogram illustrated. The volunteers were asked to mention specific areas where the pictograms could be improved upon in order to be more easily understood.

Study participants

Study participants were willing patients, adults and children who visited the Federal Medical Centre Pharmacy for prescription filling and children who were admitted in the paediatric ward of Federal Medical Centre.

Inclusion criteria

Patients and parents who speak English Language and willing to participate in the study were included. Moreover, patients and parents must be over 18 years of age and children must be from 10-18 years old.

Exclusion

Those with sight problems and children less than 10 years of age were excluded from the study.

Sample Size

A purposive/convenient sample of 40 volunteers participated in the survey.

Literacy Assessment

The Rapid Estimate of Adult Literacy in Medicine (REALM) test for the adults and teens group (Appendix B) was administered to participants after the translucency test. The REALM consisted of 7 health-related words for adults and 66 for teens commonly used in medical settings. REALM-SF is a 7 item test versus the REALM-TEEN which is a 66 item. The scoring is different so are the grade range equivalent.

Statistical Analysis: The Statistical Package for the Social Sciences (SPSS version 20.0) was used to perform descriptive data analysis. Categorical variables were summarized using frequencies and percentages. Normally distributed continuous variables were summarized using means and standard deviations. Non-normally distributed continuous variables were summarized using modes and medians. Relationships between categorical variables were carried out using Chi Square test while pre- and post- categorical data employed the Mc Nemar tests. Ordinal and binary data were analyzed using regression analysis.

Ethical Consideration

The project proposal was approved by the Health Research Committee of the Federal Medical Centre, Abeokuta.

RESULTS

In this study, a total of 40 participants were interviewed with the majority (33, 82.5%) being adults and females representing the largest group (24, 60%). The adults were generally highly literate (7 words) 20(60.6%) while the teens were mostly 10th graders (63-66 words) (4, 57.1%). Many had completed their post-secondary education 19(47.5%). The time taken for the initial interview varied between 30 -40minutes. On the scale of 1-7(1=poor resemblance of pictogram to intended meaning; 7 = perfect resemblance to intended meaning of the pictogram), the mean score for translucency was 6.12±0.72 (4.31-6.85) which shows quite a good resemblance of the intended meanings of the pictograms.

Suggestion for improvement was given for about 3(12% ± 11.9) of the pictograms such as double crossbars being preferred over single crossbars by volunteers in representing prohibitive instruction of precaution pictograms (Table 3.1).

Even though many of the volunteers were highly literate and coupled with a sizable number of those with low literacy, the initial guessability score of 84.5% (about 33 volunteers) falls below the recommended threshold (≥ 85%). About 5(11.8%) more of the volunteers were able to recall the information correctly (Table 3.1).

Table 3.0: Socio-demographic and literacy characteristics

S/No.	Variables	(Mean ± S.D)
1	Age	32.8yr ± 14.05
2	Guessability score (initial)	84.5% ± 13.7
3	Guessability score (short term recall)	96.3% ± 5.4
4	Translucency score	6.12 ± 0.72
5	Suggestion for improvement given.	12% ± 11.9(about 3 of the pictograms)

Table 3.1 Socio-demographic and literacy differentials

	Variable		Category	Number(N)	Percentage (%)
1	Age		Adults	33	82.5
			Teens	7	17.5
2	Gender	adult	Males	11	27.5
			females	22	55.0
		teens	Males	5	12.5
			females	2	5.0
3	Realm score	adult	3rd grade and below(no reading ability)	7	21.2
			7-8th grade(4-6 words)	6	18.2
			high literacy(7 words)	20	60.6
		teens	4th-5th grade(38-44words)	3	42.9
			10thgrade and above(63-66words)	4	57.1
4	Highest level of schooling completed		primary	4	10.0
			secondary	15	37.5
			post-secondary	19	47.5
			None	2	5.0
5	Number of medications currently being consumed (median)	adult (mode)	1 drug	9	50.0
		teens (mode)	5 drugs	3	16.7

Correlation Statistics

10% of the variances in translucency are explained by suggestions for improvement in the pictograms. With a negative correlation coefficient however, the relationship was significant ($p<0.05$) (Table 3.2)

Table 3.2: Associations between variables-translucency and suggestion for improvement

Variables	Coefficient of Determination(r^2)	Level of significance (P - value)
Association between Translucency and suggestions for improvement in the pictograms	0.1	0.049

Interpretation of pictograms

It will be noted that pictograms 1-7 represented instructions on indication/side effects of medications; Pictograms 8-15 represented instructions on route of administration; Pictograms 16-18 represented instructions on frequency while pictograms 19-26 represented instructions on precautionary measures to be observed during the use of medication. It was only 20(76.9%) of the pictograms that complied with the American National Standards Institute (ANSI Z535.3) criterion of ≥ 85% comprehension initially where about 84.5% of the volunteers guessed correctly initially. This percentage rose to 96.3 ± 5.4% on recall (Table 3.1a).The number of pictograms that conformed improved substantially to 25(96.2%) when the volunteers were asked to recall the meanings about 10 minutes after they were told the intended meanings.

Table 3.1a: Interpretation of pictograms

S/No of pictogram	Pictographic instruction	Correct guesses N(%)	Recall correct Guess N(%)
1	Medication is used for back ache	40(100)	40(100)
2	Medication causes diarrhea	30(75)	40(100)
3	Medication can cause cough	35(87.5)	40(100)
4	Medication can cause constipation or is used to treat constipation	24(60)	36(90)
5	Medication can cause blurred vision	33(82.5)	37(92.5)
6	Medication can cause heartburn	34(85)	40(100)
7	Medication can cause vomiting or is used to treat vomiting	40(100)	40(100)
8	Insert medication vaginally	22(55)	35(87.5)
9	Instill medication into the right eye	40(100)	39(97.5)
10	Inhale medication through the mouth	32(80)	36(90)
11	Insert medication rectally	27(67.5)	38(95)
12	Rub medication into the hands	38(95)	40(100)
13	Take one whole tablet	40(100)	40(100)
14	Take half a tablet	38(95)	40(100)
15	Inject medication subcutaneously or under the skin at an angle 45^0	35(87.5)	40(100)
16	Take medication early in the morning	34(85)	40(100)
17	Take medication at noon	37(92.5)	40(100)
18	Take medication in the evening	40(100)	40(100)
19	Do not use medication during breastfeeding	34(85)	39(97.5)
20	Do not use medication for little children or keep away from infants	35(87.5)	40(100)
21	Do not crush tablets or capsules before use	33(82.5)	35(87.5)
22	Do not drive while on medication	32(80)	40(100)
23	Avoid use of medication in pregnant women	40(100)	40(100)
24	Store medication in the refrigerator	27(67.5)	35(87.5)
25	Take medication on an empty stomach	23(57.5)	33(82.5)
26	Do not take medication with juice or alcohol	36(90)	39(97.5)
Overall		**84.5%±13.7**	**96.3%±5.4**

Relationships between socio-demographic and literacy variables

There was no statistically significant difference (no association) in guessability score as regards the genders and age group, p> 0.05. There was a statistically significant difference across the highest level of schooling as regards the guessability score, p= 0.03. There was no statistically significant difference across the highest level of schooling, age groups and gender as regards the translucency, p>0.05. A statistically significant association existed between the REALM scores as regards the guessability score and the highest level of education completed, p< 0.05. There was a statistically significant association between the REALM score (adult) and the translucency score, p< 0.05.

There was no statistically significant relationship between the REALM scores and the gender, p >0.05. There is a statistically significant difference in the genders as regards the number of medications taken currently, p< 0.05. There is a statistically significant relationship between the highest schooling achieved and the ability to recall the pictograms correctly p=0.00. There is a statistically significant association between the REALM score and the ability to recall the pictograms correctly p=0.02(Table 3.3).There is a statistically significant difference in the ability of the volunteers to guess correctly and better on recall attempt (p= 0.000).

Table 3.3: Relationships between different literacy variables and socio-demographic variables

Relationships between variables	Level of significance (P-value)
Differences in guessability scores between the genders	0.89
Differences in guessability scores between the highest level of education completed	0.03
Differences in guessability scores between the age groups	0.38
Relationship between translucency and the highest level of schooling	0.09
Relationship between translucency and the age groups	0.27
Relationship between translucency and gender	0.05
Differences of the REALM score between the Genders for ADULTS	0.09
Differences of the REALM score between the Genders for TEENS	0.15
Relationship between the number of medications and the gender	0.03
Relationship between the REALM score (adult) and the highest level of education completed	0.01
Relationship between the REALM score for adult and guessability score	0.001
Relationship between the REALM score for adult and translucency	0.002
Relationship between the REALM score for TEENS and guessability score	0.01
Differences between pre and post(recall) guessability score	0.00
Highest school completed and correct recall guess	0.00
REALM score and correct recall guess	0.02

Regression Analysis

Linear regression

The teens had 0.56 times units more compared to adults on the translucency scale, however this was not significant (p=0.15). The females had 0.44 times units higher compared to males on the translucency scale, however this was not significant (p=0.06). Every unit increase in the suggestion for improvement in pictograms will lead to about 3 units decrease in the translucency scale, this was significant (p<0.05). Every unit increase in the suggestion for improvement in pictograms will lead to about 22 times decrease in the guessability score, however this was not significant(p=0.15) (Table 3.4)

Table 3.4: Linear regression of variables

	Independent variable	Dependent variable	Beta coefficient	Confidence interval	Level of Significance (P-value)
1	Teens Adults (Reference)	Translucency scale	0.56	-0.20 -- 1.31	0.15
2	Females Males (Reference)	Translucency scale	0.44	-0.03 -- 0.91	0.06
3	Suggestion for improvement of the pictograms	Translucency scale	-2.99	-5.40 -- -0.59	0.02
5	Suggestion for improvement of pictograms	Guessability scale	-22.58	-54.18 -- 9.01	0.16

Logistic Regression

The males were 1.09 times more likely than females to guess pictograms correctly, however this was not significant (p=0.89).The adults were twice more likely than teens to correctly guess the meanings of pictograms, however this was not significant (p=0.39).The males have 1.25 times chance compared to the females in the translucency scale, however this was not significant (p=0.80), Table 3.5.

Table 3.5: Relationships between binary variables

	Independent variable	Dependent variable	Odds Ratio	Confidence interval	P-value
1	Adults Teens (Reference)	Guessability scale	2.14	0.38 -- 12.03	0.39
2	Males Females (Reference)	Guessability scale	1.09	0.28 -- 4.26	0.89

DISCUSSION

Illustrations have been used to increase interest and meaningfulness of written information. In this study, the young adults were the major participants although the females were more. On the scale of 1-7, the average translucency score shows a good resemblance of the intended meanings. Suggestion for improvement was given for close to about a tenth of the pictograms as double bars were being preferred over single bars by volunteers in representing prohibitive instruction of precaution pictograms.

Though the illiteracy level in Nigeria is on the high side and close to one third of the population (38.2%).[19] Here, many of the volunteers interviewed were highly literate while a sizable number of volunteers were with low literacy level. The guessability score of less than 100% (i.e. 84.5%) revealed that the pictograms may not be valid help especially those that had a low literacy on the initial interpretation. The pictograms failed the ANSI criterion of ≥ 85% which means that some were quite unfamiliar to the volunteers, not easily recognized at a glance but the message was also effortlessly recalled on the second interview after a few demonstrations were given as regards the pictograms. A short term recall score of close to a 100% i.e. 96.3% revealed that the pictograms will be fathomable and will be of help to both the highly literate and those with low literacy when the instructions are verbalized as reinforcements. This fact was further demonstrated when about 5(11.8%) more of the volunteers were able to also recall the information apart from those that guessed correctly initially.

Volunteers must be able to remember the messages if the pictograms are to be used at all. Recall of the intended meanings of the pictograms had occurred in almost all the volunteers in this study. The worth of a picture is a thousand words but, when such is combined with either text or verbal reinforcements during counseling, the instructions may be remembered better and also compliance may be enhanced.[20] Houts et al. did study and found out that marked improvements occurred for medical instructions using oral instructions alone.[21] Creating stories about pictograms was suggested in improving recall of pictographic instructions. [2]Pictograms were discouraged to be the sole conveyer of pharmaceutical information in a particular study[22-23].

The adults were generally highly literate 20(60.6%) while the teens were mostly 10th graders and above 4(57.1%). Many had completed their post-secondary education 19(47.5%).

All pictographs in this study were selected from the FIP pictograms. Modifications were suggested for a few of the pictograms used notably 1, 2 and 8 while double crossbar was preferred over single cross bar in the prohibitive pictograms 19-23 and 26. It is important that pictograms are designed in tandem with the culture, beliefs and expectations of the community in which they will be used. Visual images that communicate effectively a message to one population may prove meaningless to another. A study revealed that locally designed pictograms were preferred over USP pictograms because the population of study were not familiar with the pictographs[10] and that recall rates may be higher for simple pictographs as revealed in another study.[2]The recall guessability being incomparable with the initial guessability means that the pictograms will need modifications and that they were not valid for the study population without verbal reinforcements.

A strong association existed between the REALM score and the highest level of schooling with translucency scores. A higher level of education was important to decipher the pictograms correctly from this study even though someone may be able to read and write (maybe through home school) without having much formal education. A correct guess initially and on recall however occurred more as the REALM score and level of education got higher. This revealed that the ability to read words was essential in understanding and interpreting medical/ medication instructions. This fact is then essential for compliance with hospital instructions as also revealed in another study.[24]It is however noteworthy that literacy is more than word recognition, hence for people with high literacy skills, the pictograms would be illustrations/reinforcements of what they read about and people with low literacy skills, the pictograms would be cues to help them remember what they have heard.[2] A distinct link between poor reading skills and poor health has been reported.[25,26]

Pictograms are expected to be easily recognized and interpreted and should be used by both illiterate and literate people. Alternative means of recalling instructions via pictorial aids, repetition of verbal instructions and without involving written words has been reported to be beneficial.[27] Pictograms should be created for only the most important information with benefits maximized especially where good home care is critical to the patient's survival. This fact is vital for sustainability of the initiative as a study had proved that pictograms increased the workload of workers moderately.[28] For our limited sample size, a non-significant relationship existed in this study as regards males and adults having a higher chance of making a correct guess over females and teens. They were also more prone to mention that the pictograms needed no modifications than the females and the teens. It was noticed that as the translucency and guessability score increased, there was the tendency for the volunteers to suggest an improvement that should be made. A great difference existed in the number of medications that each gender currently consumed.

CONCLUSION

A higher level of education was important to decipher the pictograms correctly from this study. The initial guessability score fell below the set threshold ($\geq$ 85%) and rose far beyond it on short term recall. This presupposes that the pictograms will only be ideal, valid and easily understood tool to be used for explaining medication instructions for males and females, adults and teens, low and high literacy patients attending the Federal Medical Centre, Abeokuta when verbal and other reinforcements were applied.

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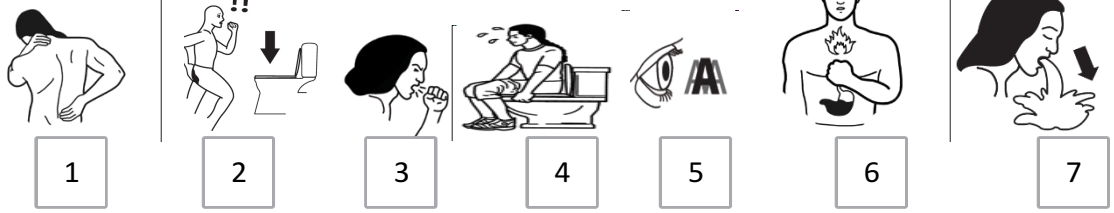
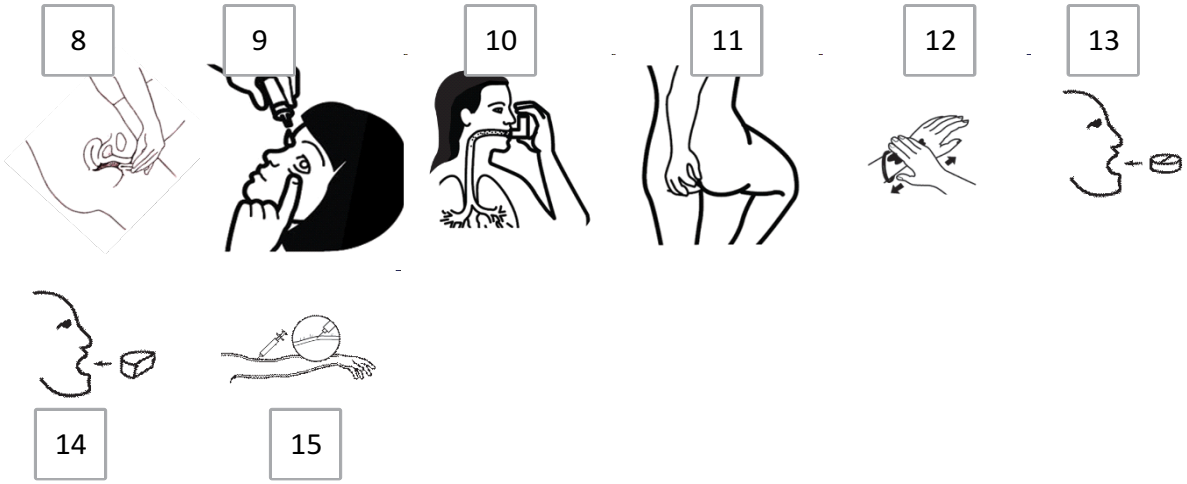
Appendix A: (Pictograms)

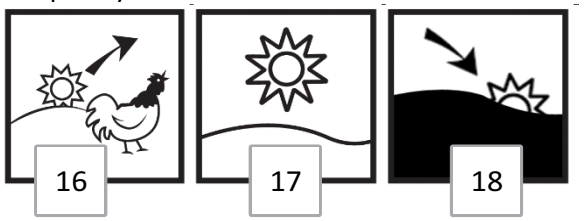
Indication/ Side Effects



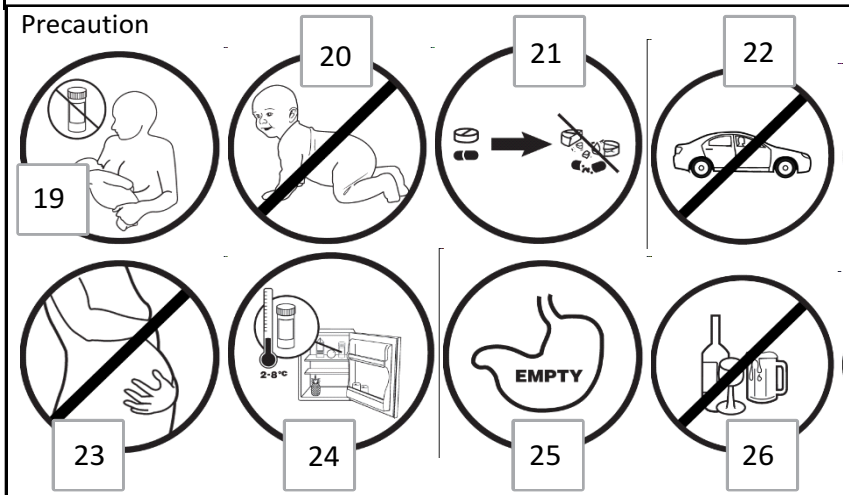
Route



Frequency



Precaution



Appendix B:
REALM-ADULT form

Race_____ Gender_____ Age_____ Grade_____ Date_____

1. **Menopause**
2. **Antibiotics**
3. **Exercise**
4. **Jaundice**
5. **Rectal**
6. **Anaemia**
7. **Behaviour**

REALM-TEEN form

Race_____ Gender_____Age_____ Grade_____ Date_____

List 1	**List 2**	**List 3**
Eye	Fever	Nutrition
Pill	Pimple	Alcoholism
Fat	Virus	Antibiotic
Skin	Calories	Complications
Throat	Allergy	Delinquency
Blood	Marijuana	Penicillin
Weight	Pelvic	Puberty
Stress	Asthma	Mentrual
Death	Emergency	Pneumonia
Liquid	Infection	Constipation
Disease	Exercise	Diagnosis
Drug	Medicine	Nausea
Mouth	Violence	Acne
Ounce	Prevention	Anemia
Heart	Suicide	Hepatitis
Risks	Depression	Adolescent
Diet	Prescription	Bulimia
Teaspoon	Abnormal	Fatigue
Period	Injury	Anorexia
Cancer	Ointment	Tetanus
Stomach	Seizure	Bronchial
Headache	Diabetes	Obesity

List 1 **List 2** **List 3**

Raw score_____

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