Pictograms for conveying medicine instructions: comprehension in various South African language groups

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The comprehension of medicine instructions is essential for the safe and effective use of medicines. In cases where low literacy constitutes a possible barrier to understanding written medicine information fully, the inclusion of pictograms may facilitate comprehension. Twenty-three internationally available pictograms and 23 corresponding locally developed images were evaluated in 304 low-literate respondents from eight different South African language groups. Demographic data were collected and an English literacy test was administered to those respondents who had stated that they could read English. Interviewees were shown the 46 pictograms in random order and were asked for their interpretation. Preference for either the international or local version was assessed. Correct interpretation of individual pictograms ranged from 14% to 97%. Images which had been developed locally were more successful in eliciting correct interpretations than those obtained from an international source (USP pictograms). Only 2 of the 23 USP pictograms achieved the 85% criterion of the American National Standards Institute compared with 12 of 23 locally developed counterparts. Local pictograms were preferred over the American ones in all cases. Standard of education had a significant influence on interpretation, whereas no significant differences in interpretation could be attributed to cultural diversity between the African language groups. Almost all respondents (98%) reacted positively to the idea of having pictograms on their medicine labels. The success of the local pictograms highlighted the value of a rigorous and consultative design and test process. Results from one African language group can reliably be extrapolated to other groups in South Africa.

Introduction

Noncompliance with prescribed medicine is an age-old phenomenon and is now regarded worldwide as a major public health problem. The consequences of noncompliance are failure of therapy, resulting in inadequate health outcomes and increased health-care costs.[1,2] In the United States, 10% of hospital admissions can be attributed to poor compliance,[3] the direct and indirect costs of which have been estimated to be $100 billion per year.[4] This aspect of medicine-taking behaviour is therefore likely to place a huge burden on national economic resources, as well as resulting in significant personal cost. Of particular importance and relevance in South Africa is the recent rollout of anti-retroviral therapy to patients in the public sector. The success of this therapy demands an extremely high degree of compliance with drug therapy, with poor compliance resulting in potentially disastrous consequences, both personally and nationally.

Estimates of compliance range from 4% to 92%, with an average of 50% compliance to long-term therapy reported to occur in developed countries.[1,5] Rates in developing countries are likely to be even lower than this. Treatment compliance is complex and multifactorial and depends on a dynamic interaction of several conditions including cognitive, behavioural, social, environmental and physiological factors.[1,2,6,7] The literature is replete with research studies investigating these contributory factors and describing the outcomes of interventions aimed at reducing noncompliance.

Poor compliance may result from a conscious decision on the part of the patient not to follow the prescribed directions, or it may be unintentional, where the patient wishes to take the medicine as prescribed but is prevented from doing so by one or more barriers. One such obstacle is low literacy, resulting in inadequate cognitive ability to read and comprehend the instructions.

Association of low literacy and poor reading skills with poor health has long been observed in nonindustrialized countries and is being increasingly recognized in developed nations. Improved literacy skills of a population have been independently correlated with better health status and higher levels of participation in preventive health.[8–11] Patients with limited literacy skills who may not be aware of the symptoms of early disease or of the necessity for therapy, may not seek timely help early in the course of a disease and are less likely to keep appointments and use screening procedures.[12] They are also less likely to comprehend and comply with the instructions of health-care providers and with written instructions for taking medication. This results in unintentional noncompliance, poor self-management skills and impaired health.[13–18]

One of the challenges facing health-care workers in South Africa is coping with a large patient population that does not have well-developed reading skills. Taking a grade 7 level as a crude indicator of functional literacy, the 2002/03 South Africa Survey conducted by the South African Institute of Race Relations[19] estimated about 7.3 million people aged 20 or older to be functionally illiterate, with the lowest functional literacy of 65.5% occurring in the African population. However, it is well known that neither formal education levels nor self-reported literacy levels are particularly good predictors of functional literacy and this conclusion is likely to underestimate the literacy problem in South African society

To facilitate the communication of health and medicine information to people with limited literacy skills, the material should be written in the patient's first language at an appropriate reading level in a simple format using basic text, and it should incorporate graphic or pictorial aids such as pictograms to complement the written text.[15] Throughout the ages, pictorials or symbols have been used to convey information, from the early cave drawings right up to present-day road signs, computer icons, hospital and airport signs, and so on. We live in an age where visual communication permeates every aspect of our lives and where modern technology relies increasingly on visual

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communication methods.

Visual aids such as pictograms stimulate the imagination and offer an alternative means of recalling instructions without involving the written word. Research on visuals and graphics shows that the memory systems in the brain favour visual storage, so a graphic message is recalled more effectively than a heard or read one.[15] Accurate interpretation of pictorial material requires a degree of visual literacy, which refers to the ability to understand, create and use visual symbols for thinking, learning and communicating, and on learning the conventions of representing three-dimensional reality on a two-dimensional surface.[20] In the absence of this learning process, visual images that effectively communicate a message to one person may prove meaningless to another.

Visual literacy is a skill that is frequently neglected in the formal curriculum, and is usually acquired informally through constant exposure to pictorial material and to the mass media. Being read to as a young child and having the meaning of pictures repeatedly explained enables the acquisition of visual literacy skills at an early age. However, for many people in this country, books are a rare commodity and there is limited opportunity for this informal educational process to occur, resulting in a reduced ability to interpret visual media.

A set of 91 standard pharmaceutical pictograms appears in the *United States Pharmacopeia Dispensing Information* (USP-DI),[21] illustrating various medicine-taking instructions. However, these were developed for use in a sophisticated, technologically advanced society and they reflect the essentially westernized base of the American culture. Graphic material is often, incorrectly, assumed to be self-explanatory and to constitute a 'universal language' which can be easily recognized and which can convey meaning with little or no dependence on language or cultural background.[22] However, each individual's perception and interpretation of visual information are influenced by his environment and his cultural base, values and communication.[15,23–25]

On studying the pictograms appearing in the USP-DI,[21] we felt that many of them contained symbols that would be unfamiliar to the majority of functionally illiterate people in this country.

The target population for pictograms in South Africa has a vastly different cultural and socio-economic background from that of the average North American. If pictograms are to be successful in aiding communication of health information, they must reflect respect for cultural values and traditions and incorporate images that are locally relevant and are easily understood.[25–27] South Africa is a multicultural, multilingual society with 11 official languages. The different language groups reflect many different cultures and traditions, and it cannot be assumed that the same pictogram would be interpreted in a similar manner by all groups.

The process for designing pictograms should therefore be a multi-stage, iterative one conducted in collaboration with the target population. It should involve designing an initial version, pre-testing it to generate feedback for modification, leading to a modified image and re-testing the amended image until an acceptable outcome is achieved.[23,24,27–29] In deciding on the acceptability of a pictogram, researchers are guided by international standards that have been established for evaluating the comprehensibility of pictorial symbols. The American National Standards Institute's ANSI Z535.3[30] and the International Standards Organisation's ISO 3864[31] advise that, in a comprehension test, pictorial symbols must reach at least a criterion of 85% or 67% correct, respectively. These standards may be considered arbitrary, but given the importance of understanding the correct medication instructions in order to use a medi-cine safely, comprehension should be above the 85% level if possible.

The objectives of the present study were to investigate the influence of collaboration with the target culture on the design and interpretation of pharmaceutical pictograms by comparing the interpretation of symbols from the USP-DI with images designed locally by our research group, and to evaluate the interpretation of these pictograms by low-literate subjects from various South African language groups.

Methods

Study sites and test population

In consultation with historians and anthropologists, historical focal areas for the different language groups were identified in various regions in South Africa. Three different geographical locations within each of these major focal regions were chosen as interview sites to minimize any potential bias associated with the use of only one area. Interview sites included hospitals, clinics, farms, taxi ranks and roadside farm stalls. Interviewees were drawn from various sectors of the community, for example hospital outpatients, domestic workers, farm workers, informal traders and unemployed people. All respondents had a maximum of seven years of formal schooling.

Preparation of pictogram sets

The initial design and evaluation process of the pictograms has been described elsewhere.[32] In total, 46 pictograms (two sets of 23) were tested. Twenty-three of these were taken directly from the USP-DI, whereas the other 23 were local modifications (referred to as local pictograms) having a meaning corresponding to each USP-DI pictogram. Pictograms were numbered and were printed in black ink on white card (11.5 × 11.5 cm).

Study design

Interviews were conducted with the aid of an interpreter by the two authors and by trained research assistants. At the beginning of the interview, the concept of using pictograms to communicate medicine-taking instructions to patients who had difficulty reading was explained. The interviewers attempted to put the respondents at ease and to make the process as non-threatening as possible by emphasizing that this was not a test of the participant's 'cleverness', but a test of the pictograms to see how good each pictogram was at communicating its meaning.

Selected demographic information was collected (gender, age, educational level, language proficiency). The ability to tell the time either from a clock face or from a digital display was determined. A short literacy test was administered to assess reading ability in English. Respondents who stated they could read were required to read a sample medication label and a short paragraph of supplementary information, and were then asked seven questions to determine their understanding. A literacy rating was calculated based on these results.

The interviewees were then shown all 46 pictograms, one at a time, in random order, with no previous explanation of the meaning of individual symbols. They were informed that the same answer could be given more than once. The respondent was asked to give his or her interpretation of each image and responses were recorded. Thereafter, each local pictogram with the USP counterpart was shown to the interviewee and the correct meaning was explained. Respondents were asked to indicate which pictogram of each matched pair was preferred and preference was recorded.

Table 1. Demographic characteristics of the different language groups.

	Sepedi n = 25	Sesotho n = 42	Shangaan n = 29	Siswati n = 29	Tswana n = 43	Venda n = 30	Xhosa n = 37	Zulu n = 69	Total n = 304
Gender									
Male	6 (24)*	7 (17)	12 (41)	6 (21)	14 (33)	8 (27)	14 (38)	19 (27)	86 (28)
Female	19 (76)	35 (83)	17 (59)	23 (79)	29 (67)	22 (73)	23 (62)	50 (73)	218 (72)
Age (yr)									
<21	3 (12)	8 (19)	3 (10)	0 (0)	0 (0)	6 (20)	1 (3)	3 (4)	24 (8)
21–40	12 (48)	9 (21)	18 (62)	18 (62)	29 (68)	17 (57)	11 (30)	47 (68)	161 (53)
41–65	10 (40)	23 (55)	7 (24)	11 (38)	13 (30)	7 (23)	20 (54)	15 (22)	106 (35)
>65	0 (0)	2 (5)	19 (4)	0 (0)	1 (2)	0 (0)	5 (13)	4 (6)	13 (4)
Education (yr)									
0	4 (16)	8 (19)	4 (14)	6 (21)	11 (26)	1 (3)	9 (24)	13 (19)	56 (18)
1—4	3 (12)	4 (10)	8 (28)	6 (21)	10 (23)	4 (13)	8 (22)	14 (20)	57 (19)
5—7	18 (72)	30 (71)	17 (58)	17 (58)	22 (51)	25 (84)	20 (54)	42 (61)	191 (63)
Stated ability to read									
First language	19 (76)	33 (79)	23 (79)	22 (76)	30 (70)	28 (93)	25 (68)	53 (77)	233 (77)
English	1 (4)	19 (45)	2 (7)	4 (14)	16 (37)	1 (3)	12 (32)	23 (33)	78 (26)

*n (%).

Different colours were assessed for preference and for any possible associated cultural importance. The same pictogram was printed in four colours (black, green, blue and red) and respondents were asked which colour they preferred, as well as any reasons for liking, disliking or avoiding the use of a particular colour. This question was intended to identify any colours which could be of cultural significance and which would therefore be inappropriate to use. At the conclusion of the interview, inter-viewees were asked for their opinion of pictograms; whether they thought the concept was a good idea, if symbols would help in reminding them how to take their medicine, and if they would like to have pictograms on all their medicines. Participants were offered an honorarium at the end of the interview to acknowl-edge their contribution and time.

Statistical analysis

Chi-square tests were used to test for significant differences in interpretation between the local and USP pictograms, and to test for significant differences in preference. Chi-square tests and regression analysis were used to assess the influence of the standard of education on the interpretation of symbols. Level of significance was set at the 1% level.

Results

Demographics and literacy test

In total, 304 respondents from eight language groups were interviewed (Table 1). The majority (72%) were female and most (88%) were between 21 and 65 years old. There were no signifi-cant differences in the standard of education among the groups. Substantial differences in stated reading abilities were noted. In seven groups, reported first language literacy ranged from 68% to 79%. This was significantly higher in the Venda group (93%), among whom, interestingly, only one (3%) could read English. Other groups with low self-reported English literacy were Sepedi (4%), Shangaan (7%) and Siswati (14%).

The English literacy test was conducted in the 78 respondents who had stated that they could read English. Eighteen subjects (23%) displayed a very poor understanding of the test material and achieved a literacy score of only 50% or less. Twenty-two interviewees (7%) displayed an average understanding and achieved a score of between 60% and 80%, and 16 respondents achieved a relatively good score of between 80% and 90%. Only 22 of the 78 respondents (7%) who had proclaimed literacy in English understood the text completely and achieved a 100%

score. This is a sobering indicator of the inadequacy of English as a sole, national language of communication and emphasizes the importance of having information available to all language groups in their first language. An overwhelming 82% were able to tell the time from a conventional clock face, whereas 10% were familiar only with a digital face and the remaining 8% were unable to tell the time at all.

General results from all 46 pictograms

The percentage of respondents giving the correct interpreta-tion of individual pictograms ranged from 14% to 97%. The local pictograms generally yielded a higher percentage of correct interpretations, with the difference being significant ($P < 0.01$) in 16 of the 23 cases. The American National Standard Institute's (ANSI) criterion of 85% correct was used as a cut-off value for ac-ceptable pictograms.[30] Only two of the USP pictograms, com-pared with 12 of the local ones, achieved this cut-off criterion. The local images were preferred over the USP pictograms in all 23 cases, and this was significant ($P < 0.01$) in 22 of the 23 cases.

Standard of education had a significant influence on the interpretation of 23 of the 46 pictograms (both USP and local). The two lowest educational groups (no formal schooling and grades 1–4) interpreted a similar percentage of the images correctly (18.6% and 19.7%, respectively). Interpretation increased substantially in respondents in the grades 5–7 group, who interpreted an average of 61.7% of the images correctly.

The complete set of 46 pictograms may be viewed elsewhere.[32] Owing to space constraints, only a limited number of pictograms will be presented and discussed in this paper (Tables 2 and 3). These were selected for a number of reasons; the interpretation of the USP version of these pictograms was significantly poorer than that of the local version ($P < 0.01$), they contained visual elements and graphical conventions which required learning for successful communication of ideas, they provoked interesting responses and many of the problems with interpretation could be attributed to lack of familiarity with the culture and lifestyle of the target population.

Pictogram 1

The USP version of this pictogram (Do not store near heat or in sunlight), with its poor interpretation of 10%, clearly illus-trates the inappropriateness of certain images and symbols. Pub-lic-sector patients in South Africa commonly receive their tablets in resealable plastic bags and so were unfamiliar with the tablet container in the USP pictogram, describing it in a variety of ways

Table 2. Correct interpretation of pictograms by the different language groups.

	Sepedi $n = 25$	Sesotho $n = 42$	Shangaan $n = 29$	Siswati $n = 29$	Tswana $n = 43$	Venda $n = 30$	Xhosa $n = 37$	Zulu $n = 69$	Total $n = 304$
1. Do not store near heat or in sunlight									
USP	5 (20)*	5 (12)	2 (7)	1 (3)	2 (5)	3 (10)	2 (5)	11 (16)	31 (10)
Local	18 (72)	14 (33)	19 (66)	10 (35)	21 (49)	27 (90)	12 (32)	38 (55)	159 (52)
2. Do not drink alcohol while taking this medicine									
USP	15 (60)	23 (55)	20 (69)	12 (41)	22 (51)	18 (60)	15 (41)	30 (44)	155 (51)
Local	20 (80)	34 (81)	26 (90)	22 (76)	41 (95)	28 (93)	24 (65)	60 (87)	255 (84)
3. Do not take with meals									
USP	19 (76)	27 (64)	15 (52)	19 (66)	23 (54)	14 (47)	21 (57)	50 (73)	188 (62)
Local	25 (100)	34 (81)	29 (100)	25 (86)	36 (84)	27 (90)	25 (68)	63 (91)	264 (87)
4. Take four times a day									
USP	21 (84)	29 (69)	26 (90)	24 (83)	36 (84)	30 (100)	30 (81)	48 (70)	244 (80)
Local	24 (96)	39 (93)	29 (100)	28 (97)	40 (93)	30 (100)	35 (95)	62 (90)	287 (94)
5. Place drops in the ear									
USP	13 (52)	24 (57)	21 (72)	14 (48)	24 (56)	18 (60)	12 (32)	34 (49)	160 (53)
Local	24 (96)	41 (98)	27 (93)	25 (86)	41 (95)	29 (97)	35 (95)	67 (97)	289 (95)
6. Insert into the vagina									
USP	12 (48)	13 (31)	14 (48)	11 (38)	19 (44)	14 (47)	10 (27)	22 (32)	127 (42)
Local	19 (76)	18 (43)	22 (76)	18 (62)	26 (61)	29 (93)	20 (54)	40 (58)	191 (63)

*n (%).

(Table 3). The 'R$_x$' convention, commonly used to symbolize medicine, was meaningless to our interviewees and added only confusing, unnecessary detail to the picture. The pictorial convention used to depict heat was highly abstract and unrecognizable and many respondents made no attempt at all to interpret this pictogram. In the local version, we avoided the use of abstract symbols and instead showed different dosage forms and attempted to represent recognizable sources of heat such as the sun and a fire. This was particularly well interpreted by the Venda participants and, although overall interpretation improved from 10% to 52%, the local pictogram is still unacceptable in terms of the ANSI criterion and therefore requires further modification.

Pictogram 2

Pictogram 2 (Do not drink alcohol while taking this medicine) and pictogram 3 (Do not take with meals) illustrate the necessity for insight into local eating and drinking habits. The wine glass, cocktail glass and beer mug (pictogram 2) were generally not recognized as being different types of glasses containing alcoholic beverages, whereas the wine and beer bottles and beer carton in the local version were much more successful and were preferred. This improved interpretation from 51% to 84%. The USP symbols are based on road sign conventions, with the single slash representing negation. This is an abstract graphic convention that has to be learnt, and the lack of familiarity with this symbolism was clearly apparent in those interviewees with minimal education, who often either ignored the slash or regarded it as an integral part of the picture, dividing the image into two halves. The slash was replaced with a cross in the local versions of pictograms containing a 'do not' instruction, and this generally improved comprehension of the negation command.

Pictogram 3

The USP version of 'Do not take with meals' consists of two parts to be read in sequence; a person taking a tablet, and the place setting. To encode fully the message of 'do not take the medicine with meals', there must be information transfer between both components of the picture. Some respondents with minimal education were unable to make the connection between these parts of the pictogram and would typically answer with: 'there is a hand and there is a plate', and could progress no further in deciphering the full message, even when prompted with the question: 'what do you think it is telling you about the medicine?'. This was the case for many similarly designed, two-part pictograms. The concept of food is introduced by showing a typical westernized place setting. The empty plate to represent the presence of food caused much confusion, and the utensils elicited many incorrect comments. These images were strongly rejected in favour of the local version, which shows a bowl containing food with a spoon as an eating utensil. This improved interpretation from 62% to 87% and was overwhelmingly preferred.
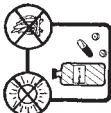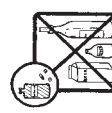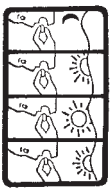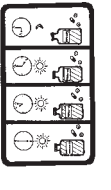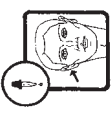
Pictogram 4

The instruction 'Take four times a day' is a direct, concrete one which is much easier to represent pictorially than more abstract concepts. Both versions were relatively well interpreted. The USP example caused some problems for those respondents with no education, as they were unfamiliar with the convention of reading a sequence from left to right. Some also saw the icon as one continuous picture or pattern and were unable to distinguish the four distinct sections. Translation tended to be literal, e.g. 'take the tablets when you see the sun and the moon'. On questioning some participants further, it became apparent that if they did not see the sun (for instance on a cloudy day), they would not take the tablets. The introduction of clocks was generally successful, with many interviewees commenting that they liked them, as they would know exactly when to take their medicine. The local version was one of the three most successful pictograms overall.

Pictogram 5

It is well documented that people with low visual literacy skills have difficulty identifying body parts when they are shown in isolation, detached from the body as a whole.[25,33] This is supported by the results from the USP version of 'Place drops in the ear'. Typically, when handed this pictogram, the respondent would rotate it a couple of times in an attempt to gain some perspective of the picture. It was usually identified as an orifice somewhere on the body and interpretation was highly education-dependent. The local version provides a context for

Table 3. Number (%) of respondents (n = 304) who correctly interpreted the symbols, their preference for either USP or local pictograms, and selected examples of misinterpretations.

Instruction	USP version	Misinterpretations	Local version	Misinterpretations
1 Do not store near heat or in sunlight	I[a]: 31 (10%) P[b]: 36 (12%)	• Take half the medicine • Take/do not take when there are clouds • Do not smoke when taking medicine • Do not take medicine and sit near a fire • Do not drink water/milk with medicine • Do not take as it is poisonous/dangerous/expired • A rubbish bin/empty tin/glass/drum/bucket • Heat source seen as clouds/mountains/smoke	I: 159 (52%) P: 268 (88%)	• Take the medicine at any time/in the morning and at night • Do not take medicine and sit near the fire/in the sun • Put the tablets next to the fire • Do not eat oranges/bananas/pineapples with medicine • Medicine will burn you/make you warm • Sun was seen as a watch • Fire was seen as a hand/herbal medicine/flowers/leaf
2 Do not drink alcohol while taking this medicine	I: 155 (51%) P: 47 (16%)	• Take one tablet with three glasses of water • Take/do not take with water/milk/milkshake • Drink the milk, water or juice • Take medicine before you drink alcohol • Jug with cotton wool inside it	I: 255 (84%) P: 257 (85%)	• Take/do not take medicine with milk/any liquids • Medicine for person who drinks a lot of alcohol • Drink alcohol first then take medicine • Do not drink milk
3 Do not take with meals	I: 188 (62%) P: 54 (18%)	• Take the medicine with food • Do not take medicine if you have not eaten • Take medicine before eating meat/after drinking tea • Cut the tablet with the knife and fork/'these things' • Do not take tablets with a knife and fork/spoon • The plate is empty, there should be food on the plate	I: 264 (87%) P: 250 (82%)	• Slash means a pair of scissors • Take three tablets before meals • Take tablest after eating food • Eat a lot of food before taking tablets • Do not take the tablets
4 Take four times a day	I: 244 (80%) P: 77 (25%)	• Do not put medicine in the sun/hot place • Take the medicine three times a day/only during the day/not in bright sun • Take the tablets when you see the sun and the moon • The sun sets and the sun rises and you take medicine	I: 287 (94%) P: 227 (75%)	• Four medicine bottles and four watches • Take the tablets in the day and at night • Take the tablets 3 times a day • Take tablets when standing in the sun
5 Placedrops in the ear	I: 160 (53%) P: 76 (25%)	• Put medicine in the mouth/eye/nose/vagina • Medicine for the lungs/headache • An injection • A shoe/upper leg/head/eye/stomach/womb/vagina • Person has a sore on his lips	I: 289 (95%) P: 228 (75%)	• Put medicine in the eye • The man put medicine into his nose as he has a sore ear
6 Insert into vagina	I: 127 (42%) P: 100 (33%)	• Take medicine and lie on your back • Inject yourself in the leg • Rub medicine onto thigh/the skin • Medicine for aborting a baby • Shows someone with a sore knee/a sore on thigh/a burn/sore hip/stomach pans • Shows a woman sitting/lying/naked/pregnant/giving birth/in the toilet/washing hands/washing private parts	I: 191 (63%) P: 204 (67%)	• Take the medicine if you are pregnant/having periods/to help you fall pregnant/have a sore stomach/have a bladder infection • The medicine makes you urinate often • Shows a woman who is naked/has painful leg/healthy and not pregnant • Rub medicine on stomach • Have an injection for contraception

[a]Correct interpretation of pictograms, n (%).
[b]Preference for either the USP or local version, n (%).

the body part and directs the viewer's attention to the ear by using an arrow as a visual cue. This dramatically improved interpretation from 53% to 95%, with only one group remaining below the 90% interpretation level.

Pictogram 6

This symbol (Insert into the vagina) presented a variety of challenges to viewers with limited visual literacy. Only part of the body was shown, which presented a problem for some subjects as they could not identify the focal body part referred to by the instruction. This two-dimensional picture represents a complex three-dimensional reality, trying to show one leg next to another, with an activity taking place between the two legs. This idea is conveyed using the graphical convention of a dotted line, which implies an activity occurring behind a solid surface. This convention was largely ignored, resulting in the most common incorrect response being to rub/inject the medicine onto/into the side of the leg. The modified version shows a greater proportion of the body, and clarifies the female gender of the figure. Again, an arrow is used as a visual cue to indicate the part of the body in which the medicine should be used. However, the improvement from 42% to 63% was still insufficient to satisfy the ANSI criterion of 85%. Another factor which appeared to influence the willingness of the respondent to offer a suggestion, was the embarrassment of speaking about an intimate part of the body. The tendency was to gloss over this pictogram and move onto the next one as rapidly as possible. This may have adversely influenced the overall interpretation.

Differences in interpretation in the language groups

Differences in interpretation were noted among the different language groups for individual pictograms, and in some cases these differences were significant. However, it is almost impossible to explain these anomalies in terms of cultural differences. The average number of pictograms interpreted correctly was compared between the groups and these results indicated that the Venda and Sepedi interviewees appeared to display the highest visual literacy skills. They were often more successful at comprehending abstract concepts, e.g. 'this medicine may make you drowsy', and in decoding the more complicated or 'busy' pictures, many of which consisted of three or four parts and had to be read in sequence.

Colour preference and opinion of pictograms on medicine labels

In assessing preference for colour, no significant differences were noted between the groups and our respondents did not appear to attach any great cultural importance to the use or avoidance of any particular colour. Green was chosen as the preferred colour by 39%, but this choice was usually based on personal preference rather than on any significant meaning. Red, black and blue were preferred by 30%, 21% and 10% of the population, respectively. The great majority of subjects (98%) reacted positively to the idea of having pictograms on their medicine, and 96% felt that these symbols could play a valuable role in helping them remember how to take their medicine.

Discussion

The importance of designing and evaluating pictograms in consultation with the target population was overwhelmingly apparent from the results of this study. All the local pictograms were better interpreted than their USP counterparts, with improvements ranging from a minimal 2% to a dramatic 42%. Although the initial development and testing of symbols was done solely in the Xhosa population, our results indicate that similar problems as well as successes were encountered in all the language groups. In the final assessment, differences in interpretation could not reliably be attributed to cultural diversity within the different South African language groups. No obvious differences in acceptance or rejection of certain graphic images or styles were identified between the groups. Generally, few significant differences in preference for either the USP or local versions were found between the groups, but where they were significant, they did not correlate with differences in interpretation.

Our target population had a high incidence of limited reading and visual skills, and different beliefs about health, cultural values, eating habits and lifestyles from the typical western-type population. Guidelines for designing pictograms for low-literate patients have appeared in the literature.[20,23,26,27,33,34] When presented with a visual image, poor readers find it difficult to identify the central focus of the visual due to their random eye movements and their lack of attention to detail on the main features.[15] Wherever possible, we attempted to simplify the images and to provide a clear focus on the main illustrated concept. The logic and experience expressed by the visual are often mismatched for the poor reader, making it more difficult to grasp the meaning of the image.[15] This was evident in the pictogram describing instructions for insertion into the vagina, where it was apparent that this was a foreign concept to many respondents. If the message cannot be encoded quickly, poor readers lose interest,[15] which we noted in the USP pictogram for 'Do not store near heat or in sunlight'. After a brief glance at the pictogram, many subjects quickly acknowledged a total lack of comprehension and lost interest in any attempts to prompt a suggestion from them. A compromised ability to read messages results in a frequent lack of understanding of instructions, and a consequent feeling that it is just not worth the effort.[15]

Despite close collaboration with the target population during the design process, it was clearly evident that pictograms, however simple, have the potential to be misinterpreted, a finding noted with concern by other researchers.[29,35] This could result in unsafe medicine-taking practices with potentially serious effects on health outcomes. The South African Department of Health and the Medicines Control Council have expressed reservations concerning the incorporation of pictograms on medicine labels and in patient information leaflets, citing the possibility of misinterpretation and its consequences as a major disincentive to their use. Although much research has demonstrated the effectiveness of pictorial material, both alone and in combination with text, on the acquisition, comprehension and recall of information,[26,36–38] some studies have contradicted these findings. Morrow *et al.*,[39] in evaluating comprehension and memory for medication schedules conveyed by different types of visual icons as well as text among older adults, found that text rather than icons was recalled most accurately. Another study, also in older adults, found that pictorials actually hindered the acquisition of medicine information.[37]

Two factors should be considered when assessing the results from this project and applying them in practice. First, the respondents were presented with totally unfamiliar images and they received no prior explanation of the meaning of the pictograms. It is acknowledged that pictures should not be used as the sole communication source as alone they have been associated with low recall of information[36] and they do not convey the level of detail needed for proper comprehension of medicine information.[27,35] Their ultimate value in practice depends largely on their appropriate use by the health-care

provider, who must offer the appropriate training and verbal reinforcement to explain the meaning of the pictogram to the patient.[24,27,39,40] Visuals used in this context serve as a memory aid rather than a primary source of information, and research has shown pictograms to be a highly effective means of stimulating recall of spoken information in people with poor literacy skills.[20,31,40]

Second, respondents were shown a total of 46 pictograms in a relatively short time, a process that required a sustained degree of concentration and was potentially tiring and confusing, particularly for those interviewees with limited visual literacy skills. In practice, however, a maximum of about four or five pictograms for each medicine would be displayed and explained at any one time.

Health-care providers have commented that extra time is required to explain pictogram labels.[34] However, the patients who would potentially derive the most benefit from these labels are, by virtue of their low literacy skills, going to be those people who would normally require additional counselling. In such cases, pictorial labels could serve as a valuable aid to expedite the communication process. Research has also shown that medicine labels and patient information incorporating pictograms are preferred over the text-only versions.[38,41]

To optimize the value of pictograms in practice, it is essential that health-care providers are aware of the potential for misinterpretation and have some idea of the incorrect meanings that may be ascribed to the most commonly used pictures. This research project, with its extensive testing of a wide range of images in low-literate respondents from a number of different South African language groups, has provided us with valuable insight into the types of graphics and symbols which are acceptable and understandable to the local population. It has laid an excellent foundation for the subsequent and current phase of our research, in which we are designing and testing patient information leaflets incorporating both text and pictograms.[38] By attempting to address the basic cognitive issues and problems in understanding medicine information, we hope to promote safer and more effective medicine-taking behaviour.

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