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Review of the quality of printed patient education materials on asthma available in primary care in Singapore

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ABSTRACT

Objective: Patient education materials (PEMs) are commonly used for patient education. This study assessed readability, format quality, accuracy, understandability and actionability of printed asthma PEMs available in primary care in Singapore.

Methods: Primary care in Singapore is provided by island-wide polyclinics and private general practices. We invited the three polyclinic healthcare groups and private general practices via the Primary Care Research Network to submit asthma-related PEMs. Readability was assessed using Simple Measure of Gobbledegook (SMOG) and Flesch–Kincaid (FK) score. Format quality was assessed using “Clear-print and large-print golden rules” from UK Association for Accessible Formats (UKAAF). Understandability and actionability were evaluated using Patient Education Materials Assessment Tool – Printed. Three pulmonologists assessed content accuracy.

Results: Thirty leaflets were assessed. SMOG and FK estimated 93% (mean 9.3, range 5–14, SD 1.8) and 47% (mean 6.8, range 2.4–9.9, SD 2.0) exceeded the recommended sixth-grade reading level, respectively. About a third (37%) were fully concordant with UKAAF guidelines, with poor format quality contributed by small font size, poor text emphasis methods, and not using left-aligned text. Leaflets generally scored well in both understandability (mean 84%) and actionability (mean 72%). Thirteen leaflets were inaccurate, 92% of which contained at least one inaccuracy judged to have potentially harmful consequences to patients, including wrong emergency advice.

Conclusion: While understandability and actionability are adequate, current asthma PEMs are limited by inappropriately high reading levels, poor format quality and inaccuracies. Healthcare professionals need to assess patients’ reading abilities and ensure PEMs are accurate and suitable for their patients.

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Asthma; patient education; Singapore; readability; accuracy; understandability; actionability; format quality

Introduction

Asthma is one of the commonest chronic conditions in Singapore, affecting 5% of adults and 20% of children (1). Despite accessibility to asthma management, Singapore’s asthma mortality rate is three times that of other developed nations (2). Much of this mortality is preventable, with two-thirds of patients who had fatal or near-fatal asthma not receiving controller medications or regular follow-ups (3). Further, an Asian study (including Singapore) found that while 73% of patients experienced one or more exacerbations in the past year, 90% reported good asthma control (4). Koh et al. describe a “mismatch between patient’s perception of asthma control and reality of outcomes (fatality, near

fatal experience, exacerbations), illustrating the issues of adherence, health literacy and misinformation” (4).

Patient education is one important way to improve health literacy regarding asthma (5). Patient education materials (PEMs) are commonly used (6), being handed out by three-quarters of US physicians (7). They augment verbal information given during consultations, and patients can refer to them at their leisure (8). Well-written and designed PEMs have the capacity to improve patient’s understanding, satisfaction and concordance with management plans (9). When patients are enabled to translate their knowledge into self-directed management, there is significant reduction in asthma morbidity (10).

The quality of PEMs for asthma has previously been suboptimal. In a UK study evaluating PEMs for asthma in

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Table 1. Comparison of Singapore and US school grades (19,20).

Age	Level of study	Singapore year	US grade
7–12	Primary education	Primary school	1–6
13–17	Secondary education	Secondary school (GCE “O” level or normal level)	7–10
17–20	Pre-university	GCE “A” level, polytechnic, Institute of Technical Education	11–12

general practices, 23% contained inaccuracies and 97% were written above the recommended reading level (11). In a similar US study, 70% were written above the recommended reading level and 40% had at least one area for improvement (12). To our knowledge, there has not been a standardization process for evaluating PEMs on asthma in Singapore, with healthcare providers obtaining PEMs from a variety of sources, including in-house production, pharmaceutical companies or online sources. Without a local regulatory framework in developing PEMs, we postulated variability in the quality of PEMs on asthma in Singapore. As there has been little such research in the Singaporean context, it is thus important to evaluate the quality of PEMs about asthma available in Singapore to identify areas of inadequacies and suggest improvements.

The assessment of PEMs requires a multi-faceted approach. Readability, defined as the reading skills needed to linguistically understand material (13), is important because materials which are not understandable serve no useful teaching role (14). Readability formulae use varying criteria including syllable count and sentence length to estimate the minimum US school grade, termed “reading level”, needed to understand the text (15). To ensure readability by the widest range of patients, it is recommended to write materials at or below US grade 6 (16,17). This recommendation can be extrapolated to Singapore’s population as an equivalent number of years of formal education in English (18), that is,

$$\sqrt{\left(\frac{\text{Number of Polysyllabic Words}}{\text{Number of Sentences}} \times (30 - \text{Number of Sentences}) + \text{Number of Polysyllabic Words}\right)} + 3,$$

equivalent to having completed primary level education (19,20) (Table 1). It is also important to assess other aspects such as accuracy, presentation format, writing style, use of visual aids and layout as these influence the accessibility, understandability and actionability of the information.

This study reviewed the readability, format quality, accuracy, understandability and actionability of PEMs on asthma available in primary care in Singapore. We focused on PEMs available in primary care because this is where the majority of asthmatic patients are managed (21).

Methods

Data collection

Primary care in Singapore is provided through an island-wide network of outpatient polyclinics managed by three polyclinic healthcare groups and private general practices. We invited the three polyclinic healthcare groups and 79 private general practices *via* the Primary Care Research Network to share their printed PEMs on asthma. We included only leaflets written in English. PowerPoint documents and materials containing tools such as Symptom diaries, Written Asthma Action Plans, the Asthma Control Test without any additional information on asthma were excluded.

Readability

Readability was assessed using two validated tools (22), the Simple Measure of Gobbledegook (SMOG) and Flesch–Kincaid (FK) score. The use of multiple tools increases reliability (23). Lower scores correspond to more easily understood text. PEMs were prepared using a standardized text extraction and text “cleaning” process for consistent and accurate computerized readability assessment (Figure 1).

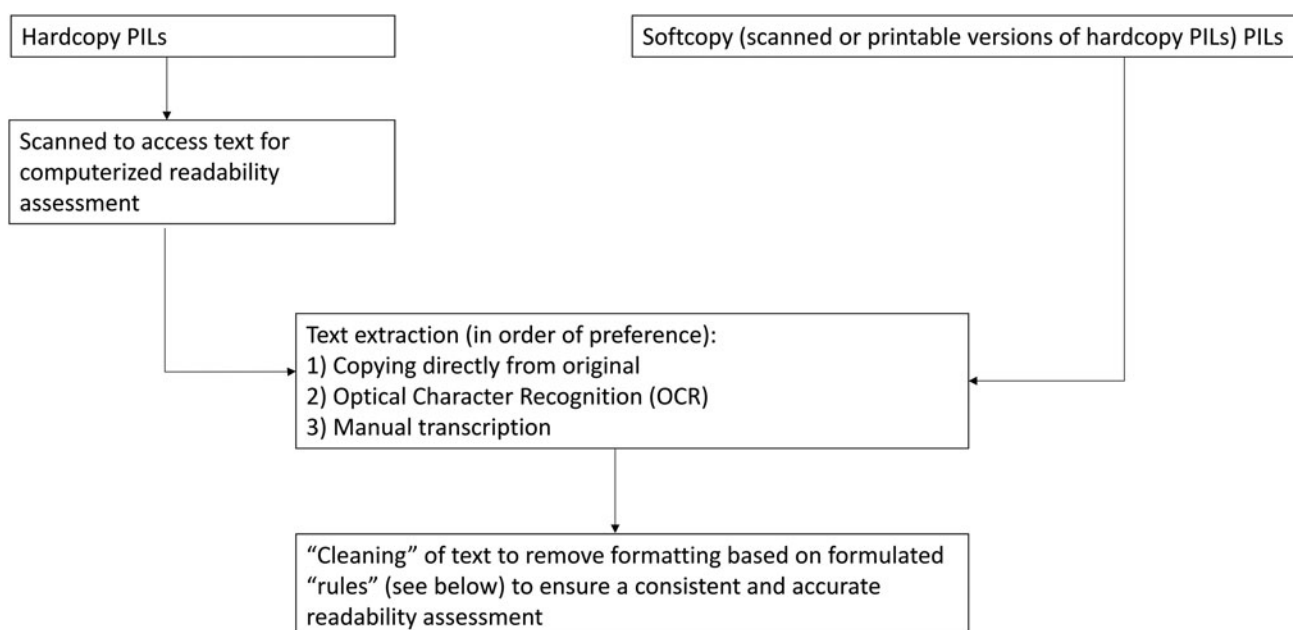
SMOG

SMOG score (24) was calculated using the formula where the maximum “number of sentences” was

limited to 30. For text containing more than 30 sentences, three 10-sentence samples taken from the beginning, middle and end of the text were used for calculation (25). The number of sentences and polysyllabic words were counted using an online calculator (26).

Flesch–Kincaid

FK score (27) was calculated using the formula $(0.39 \times \text{Average sentence length}) + (11.8 \times \text{Average number of syllables per word}) - 15.59$ available in the readability statistic component of Microsoft Word.



- 1) Text in titles, headings, sub-headings, visual aids and captions were omitted to avoid underestimating the readability scores by counting word fragments as complete sentences (54).
- 2) Abbreviations were counted as if not abbreviated i.e. spelled out (25).
- 3) Numbers and symbols were spelled out e.g. 5% becomes five percent (25).
- 4) Mid-sentence periods that might be part of an abbreviation or number e.g. "e.g. or 5.2" were removed as most computer programs recognize sentences as words ending in a period, exclamation point or question mark (25).
- 5) Copyright notices, disclaimers, author names and information and hyperlinks were omitted (25).
- 6) Any other text not directly related to patient education were omitted.
- 7) For bulleted lists, the bullet points were first assessed if they can be considered a sentence, defined as: "any string or words ending in a period, exclamation point or question mark." (25). If they can be considered a sentence, the bullet point is formatted as a stand-alone sentence, and the preamble is formatted to end with a period to replace the ":". If they cannot be considered a sentence, the preamble will be added to the front of each bullet point(s) to form a sentence. (55)

Figure 1. Process of preparing PEMs for computerized readability assessment.

Format quality

Format quality is defined as formatting features which ease the reading of print (28) and was evaluated using the "Clear-print and large-print golden rules" of the UK Association for Accessible Formats (UKAAF) (28). These rules facilitate making materials more accessible to the print-disabled, defined as anyone for whom a visual, cognitive or physical disability hinders the ability to read print. Leaflets were scored against 10 criteria (e.g. "use a legible typeface", "left align text") as "yes" or "no".

Understandability and actionability

These were evaluated using the Patient Education Materials Evaluation Tool – Printed (PEMAT-P), a

validated 24-item tool with construct validity (29). Understandability is the extent to which a reader can digest material and explain key points and is scored based on content, word choice and style, use of numbers, organization, use of visual aids, layout and design. Actionability is the extent to which a reader can recognize how to use the information. Each item is judged "agree" (1 point), "disagree" (0 points) and (if applicable) "N/A". Scores are derived from the percentage total score against the number of scored components, with higher scores ($\geq 70\%$) indicating better understandability and actionability.

Two reviewers [ZLF (family physician) and PCY (medical student)] independently rated all the leaflets.

Table 2. Leaflet concordance with UKAAF guidelines ($n = 30$).

UKAAF criteria	No. of leaflets	Percentage concordance (%)
Fully concordant with UKAAF guidelines	11	37
Legible typeface	30	100
Adequate line spacing	30	100
Clear and consistent layout	30	100
Avoid overlapping text and images	29	97
Use of non-glossy paper	29	97
Text always horizontal	29	97
Good contrast between text and background	27	90
Left-aligned text	22	73
Avoid italics/large blocks of capital letters/underlining	17	57
Use a minimum type size of 12 point	11	37

In the case of discrepancies, team discussion was used to decide upon the final scores.

Accuracy

Accuracy was evaluated by three pulmonologists (11,30) who independently reviewed 10 leaflets each against Global Initiative for Asthma (GINA) 2018 guidelines (31). For each inaccuracy identified, they were asked also to comment on whether it would have potentially harmful consequences for patient well-being or not, and to make suggestions on how to rectify the inaccuracy.

Results

We received 61 PEMs, with 30 meeting the selection criteria, comprising 20 from polyclinics and 10 from private general practices. They addressed inhaler technique and care (16), medications (five) and general asthma information (nine). We excluded 31 items because they were duplicates (11), not written in English (10), PowerPoint documents (two), targeted for COPD (three) or contained tools with no accompanying information on asthma (five).

Readability

SMOG scores ranged from 5 to 14 (mean = 9.3, SD = 1.8). Two leaflets (7%) met the recommended reading level of 6 or below, more than two-thirds (73%) required reading skills equivalent to secondary level education, and 20% required reading skills at or above pre-university level education.

FK scores ranged from 2.4 to 9.9 (mean = 6.8, SD = 2.0) with just over half (53%) meeting the recommended reading level.

Format quality

Less than half (37%) were fully concordant. Main inadequacies include font size less than 12 (63%), using italics/blocks of capital letters/underlining for

text emphasis (43%) and not using left-aligned text (27%) (Table 2).

Understandability and actionability

Mean understandability score was 84% (SD = 8.9, range = 59–92%). Leaflets scored poorly in providing a summary (6%), using visual aids to promote understandability (67%) and including clear captions for visual aids (60%) (Table 3a). Mean actionability score was 72% (SD = 15.6, range = 40–100%). Leaflets scored poorly in providing tools (20%) and visual aids (50%) to promote actionability (Table 3b). Inter-rater correlation between understandability scores was 0.64 and actionability scores was 0.59. Inter-rater reliability (percent agreement) varied between PEMAT-P items ranging from 37% to 100%

Accuracy

Of the 30 PEMs, 13 contained inaccuracies, evenly distributed between commercial (7/13) and noncommercial (6/13) sources (Table 4). Majority (92%) of inaccurate leaflets contained at least one inaccuracy judged to be potentially harmful, ranging from wrong emergency advice to recommendations to use inappropriate medicine. Wrong emergency advice included providing the wrong emergency number as the PEM was taken from an Australian textbook and outdated advice on emergency management. Inaccuracies judged to have potentially no harmful consequences ranged from misleading advice that brushing teeth after steroid inhaler use will reduce side effects to outdated recommendations to avoid sulfites as a trigger.

Discussion

Readability

Forty-six percent (46%) of PEMs met the recommended reading level when assessed by FK but not by

Table 3a. Distribution of leaflets meeting PEMAT-P criteria (understandability).

Criteria, understandability	No. of leaflets	Percentage meeting criteria (%)
The material makes its purpose completely evident ($n^a = 30$)	30	100
The material does not include information or content that distracts from its purpose ($n = 30$)	30	100
The material uses the active voice ($n = 30$)	30	100
The material breaks or “chunks” information into short sections ($n = 18$)	18	100
The material uses common, everyday language ($n = 29$)	29	97
The material does not expect the user to perform calculations ($n = 30$)	29	97
Medical terms are used only to familiarize audience with the terms. When used, medical terms are defined ($n = 30$)	28	93
The material’s sections have informative headers ($n = 18$)	16	89
The material’s visual aids reinforce rather than distract from the content ($n = 25$)	22	88
Numbers appearing in the material are clear and easy to understand ($n = 26$)	22	85
The material uses illustrations and photographs that are clear and uncluttered ($n = 25$)	21	84
The material presents information in a logical sequence ($n = 30$)	23	77
The material uses visual cues (e.g. arrows, boxes, bullets, bold, larger font, highlighting) to draw attention to key points ($n = 30$)	23	77
The material uses visual aids whenever they could make content more easily understood (e.g. illustration of healthy portion size) ($n = 30$)	20	67
The material’s visual aids have clear titles or captions ($n = 25$)	15	60
The material provides a summary ($n = 18$)	1	6
The material uses simple tables with short and clear row and column headings ($n = 2$)	0	0

^a n refers to the number of leaflets that are applicable to be scored by the criteria.

Table 3b. Leaflet agreement with PEMAT-P by criteria (actionability).

Criteria, actionability	No. of leaflets	Percentage meeting criteria (%)
The material clearly identifies at least one action the user can take ($n = 30$)	30	100
The material addresses the user directly when describing actions ($n = 30$)	30	100
The material provides simple instructions or examples of how to perform calculations ($n = 2$)	2	100
The material breaks down any action into manageable, explicit steps ($n = 30$)	26	87
The material explains how to use the charts, graphs, tables or diagrams to take actions ($n = 5$)	4	80
The material uses visual aids whenever they could make it easier to act on the instructions ($n = 30$)	15	50
The material provides a tangible tool (e.g. menu planners, checklists) whenever it could help the user take action ($n = 30$)	6	20

SMOG. FK estimates lower reading level requirements than SMOG because of its lower expected reader comprehension (75% vs. 100%) (32,33). Arguably, SMOG is the preferred assessment standard as incomplete comprehension in the healthcare context may lead to misunderstanding of information, unsafe practices and poor health decisions (22).

Based on SMOG, 93% of PEMs had inappropriately high reading levels, consistent with findings from previous studies (11,12,34) evaluating PEMs on asthma. Majority of PEMs required at least a secondary level education to understand, a level beyond the scope of 29% of Singaporeans (35). Improving readability positively influences health literacy, thereby narrowing health disparities (36), especially

important when individuals with lower educational attainment are at higher risk of developing asthma (37). To improve readability, PEMs need to be written simply, focusing on one main idea per sentence to keep sentences short and using everyday words which are usually mono- or disyllabic, whilst avoiding complex medical jargon (38).

It is important to note that readability formulae ignore reader familiarity with the subject (39). In asthma, patients may be conversant with polysyllabic terms such as “inhaler” or brand names. Recalculating SMOG after removing these terms revealed statistically significant improvements in overall readability scores ($p < .05$), though not clinically significant as only three additional leaflets now met the recommended reading

Table 4. Collation of inaccurate statements, type of inaccuracy, harmfulness and comments/improvements by type of PEM.

#	Publisher	Accuracy	Inaccurate statement	Type of inaccuracy	Harmfulness	Comments/improvements	
1	Commercial	Inaccurate	"Place the mouthpiece between your teeth but do not bite it and close your lips around it. Breathe out slowly and gently to a comfortable level"	Imprecise inhaler technique instructions	Potentially harmful	Should breathe out before placing mouthpiece into mouth	
			"The usual dose of a puffer (reliever) is 1 or 2 puffs every 3–4 h for an attack"	Wrong emergency advice	Potentially harmful	Recommended to use 4–10 puffs every 20 min for the first hour of attack	
			"Put mouthpiece in between lips"	Imprecise inhaler technique instructions	Potentially harmful	The dose may not be delivered effectively. I suggest "Put the mouthpiece in mouth and seal lips tightly around it"	
2	Noncommercial	Inaccurate					
3–4 5–16	Commercial Noncommercial	Accurate	–	–	–	–	
		Accurate	–	–	–	–	
Medication 17	Noncommercial	Inaccurate	"Seretide... helps to prevent symptoms such as breathlessness in asthma and COPD"	Misleading terminology and explanation of action of controllers and relievers	Potentially harmful	The sentence "prevent symptoms" is misleading. SABA can control symptoms too → should be reducing airway inflammation, control symptoms and reduce risk of exacerbations	
18	Noncommercial	Inaccurate	"You can also brush your teeth each time after you use your inhaler"	Misleading advice to brush teeth after steroid inhaler use to reduce side effects	Potentially not harmful	Brushing teeth does not help! Need to gargle with water	
		Inaccurate	"Steroid inhalers help to reduce and prevent swelling and inflammation in the lungs"	Misleading terminology and explanation of action of controllers and relievers	Potentially harmful	Should be airways (need to be more specific)	
19	Noncommercial	Inaccurate	"You can also brush your teeth each time after you use your inhaler"	Misleading terminology and explanation of action of controllers and relievers	Potentially not harmful	Brushing teeth does not help! Need to gargle with water	
		Inaccurate	"Budesonide is a steroid and helps to reduce and prevent swelling and inflammation in the lungs"	Misleading terminology and explanation of action of controllers and relievers	Potentially harmful	Should be airways (need to be precise)	
20	Commercial	Inaccurate	"You can also brush your teeth each time after you use your inhaler"	Misleading terminology and explanation of action of controllers and relievers	Potentially not harmful	Brushing teeth does not help! Need to gargle with water	
		Inaccurate	"call for an ambulance (in the US and Canada, dial 9-1-1)"	Wrong emergency number	Potentially harmful	Wrong emergency number (911 is for USA + Canada, 995 is for Singapore)	
21	Noncommercial	Accurate	–	–	–	–	
General asthma information 22	Noncommercial	Inaccurate	"Avoid foods (e.g. preserved foods) that contain sulphites"	Outdated recommendation of avoiding sulphites as a trigger	Potentially not harmful	No recommendations on avoiding food containing sulphites in GINA 2018	
			"Anti-inflammatory ... Sodium cromoglycate"	Inaccurate or outdated medicine recommendations	Potentially not harmful	Sodium cromoglycate not recommended for routine use due to its low efficacy in asthma control	
23	Noncommercial	Inaccurate	"Most cases of asthma in children are associated with allergy. Asthma occurs more often in those with a	Imprecise definition of asthma	Potentially not harmful	Allergic asthma is commonly associated with a past or family history of	

		personal or family history of other allergic conditions such as eczema and hay fever"				allergic disease such as eczema, hay fever, allergic rhinitis, food allergy ...
		"Examples of relievers ... Formoterol"				Formoterol is LABA: reliever should be SABA
		"Examples of relievers ... Theophylline"				Theophylline is not a SABA: reliever should be SABA
		"A nebuliser ... dispenses the medication in a mist that can be breathed in through a mask"				Through a mask or mouthpiece
		"Seek emergency medical help if the symptoms do not subside or worsen after 10 min"				Transfer to hospital if no response to inhaled SABA within 1–2 h; if unable to speak or drink or has subcostal retraction with cyanosis, if resources are lacking at home; if O2 sat <92% on room air
		"To monitor your child's asthma regularly and to know if it is well controlled use the Asthma Control Test (ACT)"				ACT not suitable for child 5 years and younger, sample as per GINA Box 6–4
24	Noncommercial	"Controllers are used to prevent asthma attacks"	Inaccurate			Controller: reduce airway inflammation, control symptoms, reduce future risks such as exacerbations and decline in lung function
		"Relievers are used when needed to stop asthma symptoms"				Reliever: relief of breakthrough symptoms, prevention of trigger induced bronchoconstriction
25	Noncommercial	"Peak Flow (for ages 5 and up)"	Inaccurate			Age 16 and above
		"Yellow Zone ... 50–79% of personal best"				More than 50% predicted or best
		"Red zone ... 50% of personal best)"				Less than or equal to 50% predicted or best
		"If I am not back in the Green zone within 20–30 min, take ..."				20 min
		"Continue using quick relief medicine every 4 h as needed"				1st hour = 4–10 puffs every 20 min. After 1st hour: 4–10 puffs every 3–4 h, up to 6–10 puffs every 1–2 h or more often
26	Commercial	"For coughing and wheezing give reliever medication (four separate puffs, one puff at a time ..."	Inaccurate			GINA recommends two puffs instead of four
		"Asthma is a common chest condition that affects the small air passages (bronchi) of the lungs, which are very sensitive"				Definition is wrong
		"relievers (such as ... Atrovent)"				Reliever should be SABA. Atrovent is not SABA
		"preventers (such as QVAR, Pulmicort, Flixotide, Tilade and Intal) that help				Not up to date. Confusing. Potentially harmful

(Continued)

Table 4. Continued.

#	Publisher	Accuracy	Inaccurate statement	Type of inaccuracy	Harmfulness	Comments/improvements
27	Commercial	Inaccurate	prevent attacks by treating the inflammation in the airways"	Wrong emergency advice	Potentially harmful	Repeat 20 min if needed
			"... take four breaths from a spacer with a face mask for infants) over 4 min and then repeat as needed"			
			"While waiting for the ambulance, give your child four puffs of reliever medication (such as Ventolin) every 4 min using a spacer device)"	Wrong emergency advice	Potentially harmful	Six puff of salbutamol or 2.5 mg neb every 20 min if needed
			"the 'preventer' (such as Pulmicort, Flixotide, Alvesco, QVAR, Tilade or Intal)"			
			"the 'reliever' (such as Bricanyl, Oxis, Ventolin or Atrovent)"			
28	Commercial	Inaccurate	"Call (000) and say 'severe attack'"	Wrong emergency number	Potentially harmful	Reliever should be SABA
			"Most people over 8 years can test PEF accurately"	Inaccurate age range or cutoff recommendations for using PEF to monitor symptoms	Potentially not harmful	Wrong emergency number. 000 is not for Singapore, 995 is for Singapore. Wrong information → delay in receiving treatment → increased risk of fatality 6 years and above
			"2. Take four separate puffs of your reliever puffer (one puff at a time) via a spacer device. Take four breaths from the spacer after each puff. (if you don't have a spacer use the puffer on its own.) 3. Wait 4 min. Take another four puffs if there is no improvement. 4. If little or no improvement, CALL AN AMBULANCE IMMEDIATELY (dial 000) and state that you are having an asthma attack. Keep taking four puffs every 4 min until the ambulance arrives"	Wrong emergency advice	Potentially harmful	Steps 2–4 all wrong (outdated)
29–30	Commercial	Accurate	"CALL AN AMBULANCE IMMEDIATELY (dial 000)"	Wrong emergency number	Potentially harmful	Change to local emergency number

level. This limitation of readability formulae could be overcome by incorporating user testing of actual and perceived difficulty of words (40).

Format quality

PEMs generally scored poorly for format quality, and we propose several improvements; larger font size (>12) and keeping text left-aligned improve accuracy and speed of reading (41). Bolding for text emphasis is preferred to italicizing, underlining or blocks of capitals as these decrease text accessibility (28).

Understandability and actionability

PEMs scored well with mean scores exceeding the minimum recommended score of 70% (29). Suggested improvements include summary sections to direct patient attention to key points to improve retention of key material and action on information (42). Also needed are more appropriate visual aids to increase attention and information recall (43). Inappropriate visual aids that are extraneous or serve only to embellish the leaflets are of no benefit and may even be detrimental to reader comprehension (44). To promote patient self-management, leaflets should ideally include tools to aid in action. For example, medication adherence aids, for example, medication calendars have been shown to improve asthma quality of life and coping (45).

Accuracy

It is concerning that many inaccuracies were judged to be potentially harmful. Patients need accurate information, and healthcare professionals should regularly check PEMs against practice guidelines and correct them accordingly, for example, appropriate emergency number if using PEMs from a non-local context. There has been much work internationally into a standardization process for information material going out to patients, such as supervision of Patient Information Leaflet production by the Data Coordination Board in the UK NHS. A review process would allow for correction of misleading information and ensure consistent, endorsed information is being provided to patients (46).

Data collection

The response rate from private general practices was very low (13%, 10 out of 79). Half of those who responded mentioned they did not use PEMs for

asthma patient education, with some preferring to provide only verbal information and others drawing diagrams instead. While we do not know how representative these respondents were, we intuitively suspect that the ratio of PEMs available to no PEMs available may be even lower amongst non-responders. A further study with different methodology to explore the unavailability of PEMs on asthma in general practices is needed.

The absence of PEMs, particularly in the waiting room, is possibly a missed opportunity for patient education. Patients spending time waiting are likely to notice and browse education materials that promote better health (47). When patients review education materials before the consultation, more time can be allocated to answering specific enquiries and concerns, which improves patient–physician communication, shared decision making and patient satisfaction (48).

PEMs in a multi-lingual society

Due to resource constraints, we were unable to analyze the non-English PEMs identified. Singapore is a multi-lingual society, where two-thirds (63.1%) do not speak English as the main language at home (49). Hence, high quality PEMs written in the three other official languages (Malay, Tamil, Mandarin) (50) are equally important, especially for those patients more comfortable learning in their mother tongue (51).

Strengths, limitations and future research

A strength of our research includes using multiple assessment criteria to evaluate different aspects of the PEMs, which provides a more holistic evaluation of the quality of PEMs.

Patients were not involved in the PEM design or evaluation process. PEMs designed with patient involvement have been found to be more relevant, readable and understandable (52). With the aim of creating an “ideal” leaflet, future research could involve patient feedback and testing of understanding to assess the acceptability and effectiveness of leaflets.

Inter-rater reliability of PEMAT scoring was lower than in previous studies (53). Some disagreement arose from poor clarity of the scoring criteria. For example, it was unclear on how to score PEMs which did not provide tools for action, but raters could not think of a meaningful tool that could be included (PEMAT item 23, supplemental material Appendix A). A more clarified version of the PEMAT would

ensure more consistent interpretation of scoring criteria.

Due to resource constraints, PEMs were distributed evenly between the specialists, though ideally having all leaflets evaluated by all three specialists would improve reliability.

Conclusion

Effective patient education can be achieved using PEMs. While understandability and actionability are adequate, accessibility of current asthma PEMs available in primary care in Singapore is limited by inappropriately high reading levels, poor format quality and inaccuracies. Especially concerning is wrong emergency advice included in PEMs which could lead to significant patient harm if care is delayed and inadequate. Healthcare professionals need to recognize their responsibility to assess patients' reading abilities and difficulties, and ensure that PEMs are accurate and suitable for their patients.

Declaration of interest

No potential conflict of interest was reported by the authors.

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