

INTERNATIONAL EMERGENCY MEDICINE

Message in a bottle: How evidence-based medicine and a programme change model improved asthma management in a low-income emergency department in Papua New Guinea

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Abstract

Objective: To improve asthma care in a complex, low resource, developing country setting. This observational study was carried out in a challenging low-income real-life setting in the ED at Modilon Hospital, Papua New Guinea. The only government hospital in Madang Province, with 258 beds, it provides medical care to a population of nearly 700 000 people of whom 40% live on less than US\$1.25/day.

Methods: An asthma management analysis questionnaire followed by action research, with a four-step programme change model (exposure, adoption, implementation and practice), were used to develop and implement new department asthma guidelines. Staff perceptions were gathered via discussion groups and questionnaire.

Results: Asthma management initially involved frequent antibiotics, intravenous steroids, multiple short acting bronchodilators (oral, inhaled and nebulised) and limited oral steroids. No spacers, preventative inhaled steroid therapy or asthma action plans were used. On review

after new guideline implementation staff felt antibiotic dispensing and concurrent use of multiple short acting oral bronchodilators decreased and spacer, preventer therapy and action plan use increased.

Conclusion: This project highlights the difficulties experienced with change management, both in general and in a limited resource setting. Lack of data limits conclusions about asthma management improvement. However, positive trends were apparent and make this approach reasonable for those considering change management strategies in a similar setting.

Key words: *asthma, low-income country, programme change model.*

Background

Evidence-based guidelines for the treatment of asthma are well established; however, little is known about prevalence and management in low-income countries or how to successfully implement evidence-based guidelines in the complex setting of a low-resource ED. Papua New Guinea (PNG) has a paucity of

Key findings

- Existing asthma management included excessive antibiotic use, no inhaled preventative therapy, no spacer use and no action plans.
- A programme change model and action research framework helped develop local guidelines resulting in a positive trend towards evidence-based management.
- Change management and data collection are difficult, particularly in limited resource settings.

asthma research over the last two decades.¹ Sub-optimal asthma management impacts patient quality of life, has broad socio-economic implications and is a significant contributor to the global burden of disease.² In 2014, the World Health Organization (WHO) identified asthma as an explicit global health priority, as each year, worldwide approximately 250 000 people die prematurely from asthma, the majority with preventable risk factors.³

Importance

Although linked historically and geopolitically to Australia, PNG has some of the worst health and development outcomes globally. The Human Development Index ranks PNG 157 out of 187 countries and as 87% of the population live

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rurally, PNG faces significant challenges in health provision and management.⁴ Remote villages and lack of infrastructure and transport impedes access to health facilities and heightens the need for good asthma management. The economic impact of asthma is greater in low-income countries and is projected to increase with development and urbanisation.⁵ Asthma continues to be a low priority for the PNG National Department of Health, while communicable diseases like malaria, HIV and multidrug resistant tuberculosis (TB) present major challenges.⁶ However, good asthma control should lead to a lower economic burden, reduced healthcare costs and ultimately fewer ED attendances.⁷

In a low-income setting, culturally sensitive change management that builds capacity and leads to improved sustainable outcomes, can be overwhelming and feel impossible. A framework for new guideline implementation helps avoid a chaotic response and this article describes how a four-step structured approach (originally described by Simpson⁸) was used to change and update asthma management in a low-resource setting.

Aim

To use a culturally safe and structured approach to transfer evidence-based medicine into clinical practice, within the constraints of a low-resource environment, and ultimately, to improve asthma management in the ED at a PNG hospital.

Methods

Context

The study was based at the ED, Modilon Hospital, Madang, PNG. Modilon is a 258 bed government hospital servicing a population of 700 000 and faces many unusual challenges beyond those of an average ED including: the abduction of doctors for ransom or as a result of cultural warfare, inconsistent funding provisions, and legal action against the CEO.^{9–11} No electronic or consistent paper documentation of patient presentations, triage or clinical diagnosis

exists. Additional ED challenges include: inconsistent electricity, intermittent running water and unreliable stock supply with frequent shortages of basic medications. The ED is staffed by doctors, nurses and Health Extension Officers.¹²

All ED staff (total 20) were invited to take part at any point during the study period (August 2016–January 2017). The change management process was led by a volunteer Australasian College for Emergency Medicine advanced trainee who was supported by Australian Volunteers International.

Modilon Hospital Ethics Committee gave ethical approval.

Study design

We used a three-phase study design within an action research framework. Action research has the dual aims of action to bring about change, and research to increase understanding (in the researcher and/or the participants) of why change occurred and the consequences of change. It is typically cyclic, qualitative and participatory.¹³ Cultural sensitivity and flexibility were maintained throughout.¹⁴

Phase 1: Asthma management analysis

Questionnaire (Table 1) completed by ED staff during consultations with known asthma patients (after consent) over a 2 week period. Patients were excluded if they had alternative diagnosis to asthma or known or suspected TB, bronchiectasis, pleural effusion or cardiac disease. The principal researcher delivered opportunistic clinical teaching during patient consultations.

Phase 2: Programme change model

1. **Exposure:** Didactic teaching sessions for ED staff including pathophysiology of asthma, clinical assessment, diagnosis and management issues. Staff developed an action plan to identify the practice changes required and the methods for implementation. 'Asthma champions' were elected to support the project.

2. **Adoption:** The hospital Director of Medical Services and ED Director approved the programme.
3. **Implementation:** Education, discussions and review sessions were held to ensure cultural safety and implement the new guidelines. Ongoing bedside teaching and support was provided. Staff feedback was sought throughout and adaptations continually made in response to suggestions.
4. **Practice:** Staff began using the ED guideline, translated action plans and dispensing department-made spacers, steroid packs and steroid inhalers.

Phase 3: Re-analysis of asthma management

At 3 months, the questionnaire was repeated and informal feedback solicited from hospital and ED stakeholders.

Outcome measures

- Patient/staff perception of reduced hospital visits to the ED because of asthma
- Percentage of cases:
 - where antibiotics given
 - using/treated with a spacer
 - given recommended dose and duration of oral steroids
 - with asthma action plan
 - using inhaled corticosteroids
 - where inhaled corticosteroid prescribed on discharge

Results

Phase 1

Thirty-five patients (21 females, 14 males) were recruited to the study ranging from 2 to 50 years of age and mostly attending the ED one to four times a month for asthma. Table 2 provides further demographic and asthma treatment details.

Phase 2

A series of changes were initiated in response to phase 1 results and adapted in response to staff suggestions and feedback:

1. **Development of Modilon ED asthma guidelines.** Developed

TABLE 1. *Asthma study stage 1 – Questionnaire*

Sex	Male/female
Age (years)	<15/16–20/20–50/>50
Time taken to get to hospital	<1 h/1–2 h/>3 h
Average number of ED attendances in a month because of asthma	<1/2/3–4/>4
Which asthma medications are they prescribed?	Salbutamol PO/inhaler Aminophylline PO Prednisolone (dose...)
Do they take their asthma medications regularly?	Yes/No
Were the patient's vital signs recorded on arrival?	Yes/No
Has the patient used the nebuliser before?	Yes/No
Does the patient know what a spacer for asthma is?	Yes/No
Treatment while in ED	Oxygen Salbutamol PO/ nebulised/spacer Steroids PO/IV Antibiotics PO/IV
Admitted to ED or medical ward?	Yes/No
Discharge medications	Yes/No Salbutamol inhaler or PO Antibiotics Paracetamol Steroids (dose...) Aminophylline

using British Thoracic Society/Scottish Intercollegiate Guidelines Network 2016 guidelines, Australian Asthma guidelines 2016 and PNG Standard Treatment Guidelines (STG).¹⁵

- 2. Introduction of steroid inhalers.** All staff were unaware the 2012 PNG STG listed beclomethasone for use in chronic asthma and thought it was unavailable. The hospital pharmacy had stock and supplied inhalers for ED dispensing.
- 3. Introduction of spacers.** Staff felt spacers needed dispensing with inhalers for usability and improved infection control. Spacers are not available to buy in PNG and prohibitively expensive when sourced internationally. Expired 500 mL intravenous (IV) fluid bottles were free, more abundant than plastic drink

bottles, had a good size mouth piece and plastic soft enough to cut with a scalpel blade, making perfect spacers (Fig. 1).

- 4. Standardisation of oral steroid use to international recommendation (40 mg for 5 days).** Staff prepared 'take out packs' of prednisolone that reinforced correct dosing and use of oral rather than IV steroids where appropriate.
- 5. Reduction in antibiotic use.** Education sessions recapped the signs and symptoms indicating antibiotic use.
- 6. Change in 'quick list prescription'.** Pre-printed prescriptions exist for a few conditions, including asthma; meaning staff can tick each medication they want to prescribe rather than writing. Printed prescriptions were updated to include standard steroid dosing, steroid inhaler, and a

prompt to check if antibiotics were indicated and no longer included oral salbutamol or aminophylline.

- 7. Locally appropriate asthma action plans.** Asthma action plans were developed using the Remote Indigenous Australian Asthma Action Plan template, translated into Tok Pisin and illustrated with photographs of staff demonstrating spacer and inhaler use (Fig. 2).¹⁶
- 8. Provision of educational resources for staff and patients.** Staff were considerate of low-literacy rates and used pictures and photographs for patient education where possible. Creating and translating this material became a cohesive and educational part of the change process.

Phase 3

Findings and changes were presented at hospital grand round and local and national media covered the story (Fig. 3). Despite strong encouragement, only three patients were recruited to the follow-up questionnaire at 3 months (two females, one male), one 21–50 years old and two >51 years of age, two attended ED less than once a month on average and one 1–4 times a month. Two of these patients received salbutamol nebulised and through a spacer, one patient had PO steroids before discharge and none were admitted. Two were given discharge medications (both received a salbutamol inhaler and one received steroids (40 mg for 5 days)).

After 3 months a staff survey was provided for anonymous feedback and received six responses. All six felt their asthma management had changed and that asthma-related ED attendances had decreased but more bedside education would be helpful. Negative comments about the programme included: fears the programme would die out due to 'man-power'-related issues, lack of equipment or lack of an allocated member of staff to run the programme.

TABLE 2. *Results of patient questionnaire*

Gender	
Male	14 (40%)
Female	21 (60%)
Age group	
Less than 15 years	5 (14%)
Between 16 and 20 years	15 (43%)
Between 21 and 50 years	15 (43%)
Distance travelled to attend ED	
Up to 1 h	32 (91%)
1–3 h	2 (6%)
More than 3 h	1 (3%)
Average number of ED attendances in a month because of asthma	
Less than once per month	13 (37%)
Two times per month	22 (63%)
Questions	Yes (percentage)
Current regular asthma medications	
Salbutamol inhaler	19 (54%)
Salbutamol tablets	15 (43%)
Aminophylline tablets	15 (43%)
Prednisolone tablets	0
Does the patients take their medications regularly?	33 (94%)
Vital signs recorded on arrival	13 (37%)
Has the patient used a nebuliser before?	29 (83%)
Does the patient know what a spacer for asthma is?	3 (8%)
Treatment given in ED	
Oxygen	3 (9%)
Salbutamol nebulised/PO/spacer	34 (97%)/0/0
Steroids PO/IV	8 (23%)/16 (46%)
Antibiotics IV/PO	14 (40%)/0
Adrenaline	1 (3%)
Admitted to ED or the ward	13 (37%)
Medications given on discharge	32 (92%)
Discharged with salbutamol inhaler or PO	21 (60%)
Discharged with steroid inhaler	0
Discharged with paracetamol	17 (49%)
Discharged with PO steroids (dose range 4–40 mg)	6 (17%)
Discharged with PO aminophylline	18 (51%)
Discharged with PO antibiotics	28 (80%)

Discussion

In PNG we found excessive antibiotics use, heavy reliance on multiple

reliever therapies and no use of preventative therapy or action plans, similar to the findings of the work done in the Solomon Islands.¹⁷ Lack

of preventer therapies, spacers or action plans is associated with increased morbidity and mortality in asthmatic patients.¹⁸

Plastic bottle spacers have been recognised for over 15 years as an alternative to commercial spacers in low- and middle-income countries.^{19,20} The slow translation of evidence into practice is critical for asthma management, as the ED is often the only medical contact for many in PNG. Multiple factors make it difficult to use and follow guidelines in a low-income context; STG are followed in as few as 35% of patients in the West Pacific Region, including PNG.²¹ Confusion about medication availability is confounded by intermittent stock supply and discrepancies between the content of pharmacy catalogues and STG recommendations.²²

The recognition that spacers are equivalent to nebulisers for the treatment of mild and moderate asthma has unfortunately not translated to practice in the Asia Pacific region and the reason is not well understood.²³ Barriers are likely to be complex, and may include water-bottle cost given PNG has a national poverty rate of 37%.²⁴ In the Solomon Islands, there is a widespread belief that inhalers are addictive and should be avoided.¹⁷

We adapted an asthma action plan designed for remote indigenous Australians for the PNG context. This model of Australian – PNG resource sharing has been successfully used for public health training by Kitau *et al.*, and could be suitable in other health contexts.²⁵ By maximising PNG staff involvement through local language translation and photograph images, we aimed to embed local ownership and therefore sustainability and wider PNG applicability.

Peer exemplars were integral to ensuring cultural safety and ongoing practice advice. Publication and communication of the change was regular and included engagement of frontline practitioners and senior managers publicising the reasons for decisions both within the hospital and to the public. This aimed to build momentum and buy in from staff to implement the practice



**Salbutamol 'reliever' Blupela
winsot spreji i bilong opim win paip
hariap.**

**Steroid 'preventer' Winsot spray bilong
banisim winsot sapos u usim olgeta
moning na olgeta nait**

Figure 1. Use of preventer and reliever therapy with a spacer.

guidelines and to be recognised as a leading asthma management in ED care in PNG.

Monitoring and evaluation of the practice was challenging. Introducing performance-based mechanisms of accountability can create a sharp dichotomy between the formal and informal rules in developing countries, where there is often a predominance of informal rules that are non-bureaucratic.²⁶ There is always risk when implementing change that you do more harm than good. We considered the potential adverse effects and our efforts to mitigate these (listed below).

- **Patients misunderstand preventers as relievers.** Colour action plans were dispensed showing a blue inhaler as reliever and white as preventer with posters explaining the difference (in pictures and Tok Pisin) in the ED asthma bay.
- **TB patients may not be identified and a course of steroids could accelerate disease.** Bedside teaching, increased awareness of TB (the WHO launched a new TB programme during the study period), and poster above the ED asthma bay chair hopefully helped as a reminder to send potential TB patients directly to TB clinic.
- **Spacers may be shared between patients, acting as a vector for TB transmission.** Spacers were dispensed as single patient items and are no more likely to spread infection than recycled nebuliser

masks, close confined sleeping quarters, ED waiting room or hospital wards.

Our impression was that overall, the benefits would outweigh these risks.

This study heralded many firsts for the department including the first guideline used for clinical management, spacer use, local asthma action plans, standardised prednisolone doses for asthma attacks and the first use of steroid inhalers. Box 1 lists some study highlights.

Limitations

No 24-hour triage or reliable record keeping service exists and many deaths are recorded as 'unknown' making it impossible to analyse whether the change management will have any objective effect on asthma-related ED presentations, morbidity or mortality. Patients often lack birth certificates so many ages are estimates. Time to hospital is difficult to assess and variable (dependent on weather, road conditions, access to funds and frequency of public motor vehicles). Under developed information and data collection systems make research difficult and likely contribute to sub-optimal management.

Asthma diagnosis in the department is purely clinical and lack of education likely leads to some misdiagnosis, diagnostic inertia and therefore treatments may seem

'ineffective'. Without Peak Flow meters or spirometry, it was impossible to test the efficacy of IV bottles as spacers.

In the initial analysis of asthma management, we failed to make the distinction between inhaler and oral salbutamol clear enough. As a result, it was not possible to differentiate between oral and inhaled therapy on discharge, these were therefore considered together in the analysis. Clearer listing on the questionnaire as two separate lines (rather than PO/inhaler) would have resolved this.

Most data collection occurred from 08.00 to 17.00 hours, Monday to Friday during Australian volunteer onsite times while the paediatric out-patient department was also open giving a study bias towards adult patients. The department guideline was created for adult patients in recognition of this.

We were only able to gather extremely limited follow-up data and therefore are not able to make any objective observation of improved asthma management over time. Through limited staff response and informal hospital and ED feedback, it seems possible that asthma management for some patients has improved, and staff felt their own

BOX 1. Study highlights

- The process of translating education booklets and asthma action plan helped understanding, staff cohesion and increased usability of educational material.
- Patients began asking for the 'new asthma treatment'.
- The national newspaper ran two stories in print and online and the local Tumbuna television channel ran a 15 min segment on the study.
- Introduction of steroid inhalers, not been used previously but available, was a key positive change in improving asthma management.

SOT WIN AKSEN PLEN

Name: _____

Doctor or clinic: _____



Pilim olrait

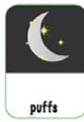


2
spray

1 spray = 4 pulim win

Marasin save wok gut wantalm
spacer/ botol

Usim wait pela spray olgeta talm mask
u pilim orait.



puffs

puffs

Pilim lik lik
sot win



4
spray

1 spray = 4 pulim win

Sapos yu usim Blu pela spreit 3 pela
talm long wanpela wik. Yu mas
kam long hausik long kism wait
pela spreit long go wantalm.



puffs

puffs

Bikpela
sot win



4 spray
Wait sampla
minit
Ripitim gen
Inap sot win go
daun

1 spray = 4 pulim win

Sapos u kism 10 pala win
bihain lo olgeta 4 aua.
**ORAIT U MAS KAM LO
HAUSIK HARIAP TASOL!!!**



SHORT WIND ACTION PLAN

Name: _____

Doctor or clinic: _____



Feel Good



My medicines:

1 puff into spacer
at a time.

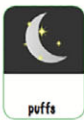


2 puffs

1 puff then 4 breaths

The medicine works best with spacer

Use the white puffer every day even
when you feel good



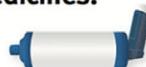
puffs

puffs

Feel little bit
Short Wind



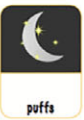
My medicines:



4 puffs when needed

Always carry your blue puffer & spacer

If using blue puffer
3 x week see doctor to
increase your white puffer
dose



puffs

puffs

Bad
Short Wind



My medicines:



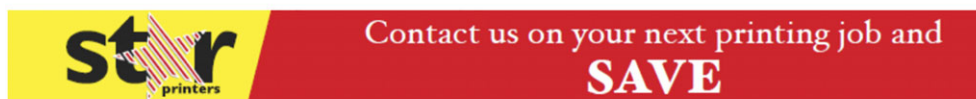
4 puffs
Wait few minutes
repeat
until better

1 puff then 4 breaths

**IF using 10 puffs every 4
hours GO TO HOSPITAL!!!**



Figure 2. Asthma action plan in Tok Pisin and English translation.



New machine for asthma

January 5, 2017 The National Health Watch

Article Views: 35

THE Modilon General Hospital is using a new medicine for asthma and has a new asthma management plan rolled out in the Emergency Department, an official says.

Medical Services director Dr Vincent Atua said it was the first time this approach for asthma management had happened in the country.

He attributed it to good teamwork and innovation from staff in the Emergency Department at the hospital.

"Each year 250,000 people die early from asthma and most of those had preventable risk factors," Atua said.

"It is hard for people to come to hospital so we want their asthma controlled so that they do not have to come to hospital as often.

"We also want people and their families to know how to treat an asthma attack as this can save a life."

He said the steroid preventer inhaler, if used every morning and night, could help prevent asthma attacks.

"All asthma patients were now receiving a personal asthma action plan which is hoped to reduce morbidity and mortality in Madang," he said. Asthma is a disease of the air-ways that makes you cough, feel short-winded and the chest is tight and wheezy.

It comes and goes and is often triggered by dust, rain, exposure to some animals and sports.

People with asthma have narrow air-ways because the muscles get tight and the walls become inflamed.

Figure 3. Local and national media coverage.

asthma treatment had changed. Staff quite rightly worried that without local leadership and resources, the improvement programme may not be sustained. Our inability to successfully perform follow up over the longer term illustrates the challenges of attempting research in low-resource environments without dedicated staff, time, funding or data collection systems. Relying on clinical staff, who are often overwhelmed with service provision needs, to initiate and drive research follow-up activities is extremely difficult.²⁷

Many of the substantial limitations were unavoidable because of the setting. However, this does not invalidate the integrity of the initial change management methodology and local staff engagement.

Conclusions

Despite seeing positive trends, the low number of responses mean that

we are unable to conclude that asthma management was improved. The project highlights the difficulty in both implementing change and doing research in a low-income ED, which for many asthma sufferers, is their only interaction with health providers. Our results were encouraging and may suggest that the project has relevance for similar low-resource settings seeking to improve clinical healthcare; however, further research is needed.

We hope this 'message in a bottle' floats around to many of the islands of the Pacific.

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Author contributions

Authorship meets the International Committee of Medical Journal Editors guidelines for authorship. All authors have made substantial contributions to the conception, design and write up of the work. All authors have been involved in the revisions, approved the final draft and agree to be accountable for all aspects relating to the work.

Competing interests

GP is a section editor for *Emergency Medicine Australasia*.

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