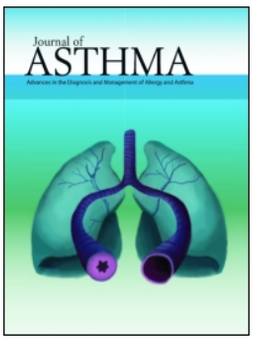

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Role of technology in improving knowledge and confidence in asthma management in school staff

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ABSTRACT

Objective: To investigate the effectiveness of technology enabled learning in improving asthma first aid knowledge and self-confidence in providing asthma first aid to children in staff within a school setting. *Study Design:* A prospective randomized parallel study using a pre and post test design was conducted across Metropolitan schools of New South Wales (NSW), Australia. School staff in selected schools were randomly assigned to receive first aid asthma management training via a self-directed multimedia eBook learning resource or standard face-to-face training. Staff completed a 14 item validated Asthma First Aid Knowledge Questionnaire and a 4 item, 10-point Likert-scale asthma management self-confidence questionnaire immediately pre and post training. *Results:* 148 school staff from 46 schools were recruited with a total of 59 (78%) staff completing the eBook training and 62 (86%) completing face-to-face training. The mean asthma first aid knowledge score and self-confidence score in managing asthma increased significantly ($p < 0.0001$) in the eBook training group post training. There was no significant difference in the increase in the mean scores post training between the eBook and face-to-face training groups ($p = 0.11$). *Conclusion:* Asthma management knowledge and self-confidence increased in school staff following the eBook training. In school settings where human resources for health education are limited, technology enabled learning may be substituted to provide a self-directed approach to asthma first aid management training.

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School-based education; health education

Background

Asthma is the most common chronic disease of childhood associated with frequent emergency department and unscheduled physician visits [1] resulting in school absenteeism and academic underperformance [2–4]. Australia has a high prevalence of pediatric asthma compared to other high-income countries [5,6] with one in 10 school-aged children having a current diagnosis of asthma [7]. Optimal management of asthma is dependent on carers understanding the pathophysiology of asthma, their ability to recognize early warning signs of poorly controlled asthma and an asthma attack and instituting appropriate asthma first aid.

With the continuous advancement in communication technologies, new opportunities including computer-based online educational tools are increasingly being used to provide knowledge on self-management of asthma. Previous studies have shown that internet based self-management education can improve asthma related quality of life in adult and pediatric patients with asthma [8,9]. Additionally computer-based education in school can improve asthma knowledge in school students. With increasing number of children with asthma in schools, school staff are also an important group of carers who may be called upon to manage an asthma attack. Previous studies have demonstrated that education programs targeting teachers are effective in increasing knowledge and awareness of asthma in school children [10].

In the state of New South Wales (NSW) in Australia, face-to-face emergency asthma management education to school staff is provided through the School Champion Asthma Management Program (SCAMP) of the Aiming for Asthma Improvement in Children (AAIC) program. To enable greater coverage of staff training, the SCAMP is based on a train-the-trainer model. However, current delivery of this model is resource intensive, does not allow for

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participation of school staff located in rural and remote regions, nor does it accommodate staff who are unable to be released from their daytime busy school schedules. A previous study has shown that technology enabled teaching is effective in increasing asthma knowledge in university students' undertaking primary education degree [11]. There is however, limited published evidence to support the role of technology enabled learning in increasing knowledge of school staff in asthma management.

Objectives

The main objectives of this study were to evaluate whether an interactive self-directed digital training manual (eBook) was effective in improving school staff knowledge and self-confidence in managing asthma. Our secondary objective was to compare this method with face-to-face training.

Methods

eBook development

The Asthma First Aid Management in Schools training eBook was developed by AAIC based on SCAMP training material and included information on asthma, triggers, medications, interactive quizzes, picture galleries, videos depicting real-life asthma first aid scenarios and demonstrations on how to use inhalation devices. It is freely available in the iTunes Book Store (https://itunes.apple.com/us/book/asthma-first-aid-management-in-schools/id1266143278?ls=1&mt=11) and takes around 60 min to complete.

Study design

We conducted a prospective randomized parallel study across different primary and high schools of NSW. Principals from all private and public schools in the Sydney, Wollongong, Campbelltown, and Parramatta metropolitan regions that had not previously received SCAMP training were contacted via email and invited to enroll their staff for participation in the study. Email correspondence was the only method of initial communication with the schools. Only eligible school staff who were available to attend a three hour face-to-face training session at various Sydney Metropolitan sites, had access to an Apple device with the eBook application installed, had literacy in English and had not previously participated in SCAMP training were included in the study.

Within each school, research staff consented staff members who were then allocated a participant number and the research coordinator randomly assigned staff to either one of two intervention groups using an online random number generator https://www.randomizer.org/. One intervention group received asthma management training via the Asthma First Aid Management in Schools eBook (eBook group). For this group, the research coordinator emailed the staff member a secure link to the eBook located in Cloud Store (https://www.aarnet.edu.au/network-and-services/cloud-services-applications/cloudstor). The second intervention group received asthma management training through one of SCAMP three hour metro Sydney face-to-face training (face-to-face group) sessions delivered by AAIC clinical nurse consultants.

The main outcome measures were change in asthma first aid knowledge and asthma management self-confidence in the school staff post eBook training. Using study unique participant number, each participant completed a pre and post training survey questionnaire to assess knowledge and confidence. The survey questionnaires were developed using a validated asthma first aid knowledge questionnaire (AFAKQ) developed by University of Sydney, Faculty of Pharmacy [11,12] and a 4 item 10-point Likert-scale asthma management self-confidence questionnaire. In the eBook group, the survey questionnaires were delivered via the online survey platform Survey Monkey® 1 week prior to emailing of eBook link and approximately 3 weeks following downloading of eBook. The face-to-face group completed their survey questionnaires onsite before and following the training session.

We also collected demographic information including the participant's education level, years worked in the school/education sector, role/position in the school, preferred learning method and personal and family history of having asthma. Participants who did not complete or return the pre and post survey questionnaires, or complete the eBook and the face-to-face training were excluded from the study.

Sample size calculation and statistical analysis

Assuming that eBook training would result in a 10% increase in the mean Asthma Knowledge Score post training compared to the pre training baseline mean score with 80% power, significance level of 0.05 and 15% drop out rate, we required 46 participants.

As sample size calculation for a previous study evaluating the impact of asthma online training in

improving asthma knowledge in university students in the final year of primary education year was based on a 15% increase post training, we kept our estimates conservative an assumed a 10% increase in asthma knowledge post training [11].

Descriptive statistics were used to determine the baseline characteristics of the study participants. The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) for both groups was calculated using the Socio-economic Indices for Areas collected by the 2011 Census of Population and Housing, available through the Australian Bureau of Statistics. Differences in the mean score pre and post intervention were calculated in an intention to treat analysis using paired *t*-tests and Wilcoxon Rank Sum Tests.

Ethics approval

Ethical approval was obtained from all NSW governing educational sectors. Written informed consent was obtained from participating school staff.

Results

Study population

A total of 1262 NSW schools were approached and 46 schools agreed to take part with 148 school staff members eligible and randomized between August and December 2016 (Figure 1). In both groups, the majority of participants were school teachers with more teachers randomized into the eBook group (41 [70.7%]) compared to the face to face group (33[53.2%]) (Table 1).

A total of 59 of 76 (78%) completed the eBook training and 62 of 72 (86%) completed the face-to-face training. Nine participants in the eBook group elected to change to face-to-face training, and one in the face-to-face training elected to change to eBook training. A total of 27 (18%) participants were excluded from the study; 17 in the eBook group and 10 in the face to face group (Figure 1).

Change in asthma first aid knowledge and self-confidence

In the eBook group, the mean asthma knowledge score pre training was 9.78 which increased by 1.94 points (95% CI 1.20 – 2.70) post training. In the face-to-face group, the mean increase in asthma knowledge score post training was 2.4 (95% CI 1.67 – 3.13). The asthma management self-confidence scores increased significantly across all questions (Table 2).

There was a greater increase in knowledge score and self-confidence score in the face-to-face group compared to the eBook group, but the difference was not statistically significant (Table 3).

Discussion

Our study has demonstrated that a technology enabled digital platform can significantly improve school staff knowledge and confidence in asthma first aid

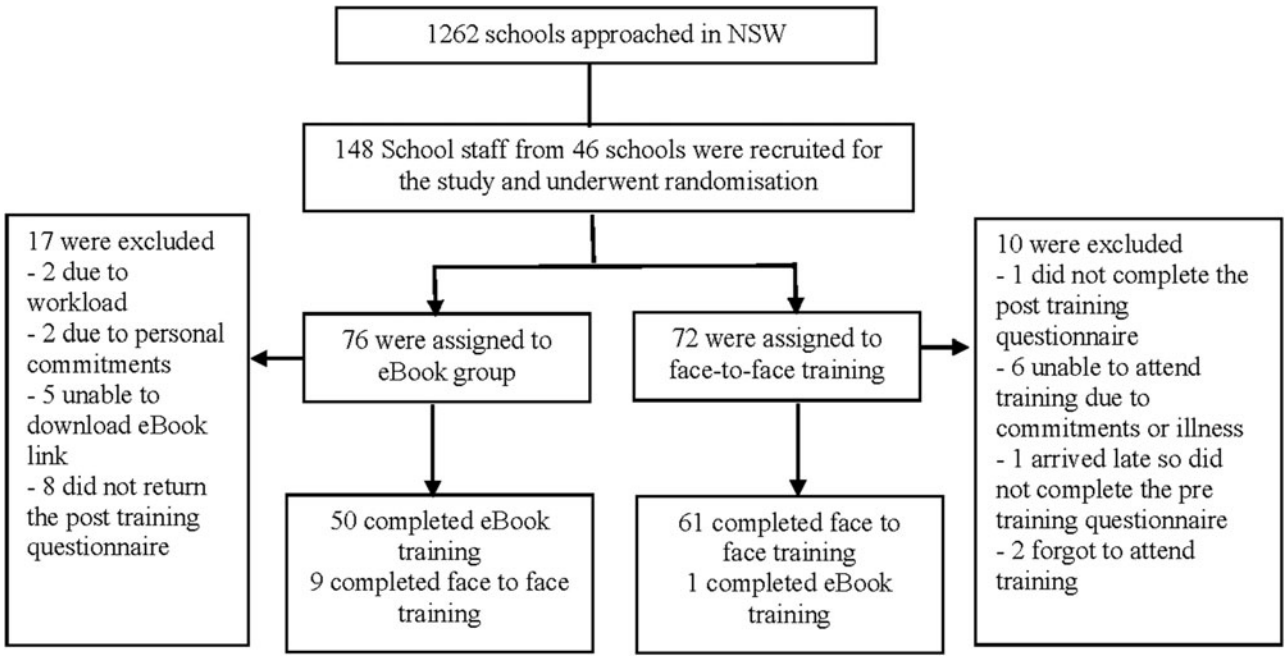

Figure 1. Flow diagram showing the study design.

Table 1. Baseline demographic and clinical characteristics of the school staff in the intervention schools staff, NSW, Australia.

Variable	eBook training *n* (%)	Face-to-face training *n* (%)
Education level		
School certificate	0 (0)	6 (9.7)
Higher school certificate	1 (1.7)	6 (9.7)
Diploma	13 (22.4)	6 (9.7)
Tertiary	26 (44.8)	24 (38.7)
Post-graduate	18 (31.0)	14 (22.6)
Staff position		
Teacher	41 (70.7)	33 (53.2)
Nurse/First-aid	4 (6.9)	7 (11.3)
Administration	8 (13.8)	13 (21.0)
Classroom assistant	5 (8.6)	9 (14.5)
Years in education		
<2	12 (20.7)	10 (16.1)
3–5	10 (17.2)	10 (16.1)
6–10	13 (22.4)	16 (25.8)
11–15	21 (36.2)	13 (21.0)
>15	2 (3.4)	13 (21.0)
Preferred learning method		
Technology-assisted	17 (29.3)	10 (16.1)
Face-to-face	41 (70.7)	52 (83.2)
Asthmatic	7 (12.1)	6 (9.7)
Asthmatic family member	20 (34.5)	24 (38.7)
Mean decile of Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) according to school postcodes	5.5	5.3

Table 2. Change in asthma first aid knowledge and self-confidence score pre and post intervention in each of the intervention groups.

Training	Variable	Pre-training mean (SD)	Post-training mean (SD)	Mean change (95% CI)	*p* value*
eBook	AFAKQ† score	9.78 (3.10)	11.72 (1.67)	1.94 (1.20–2.70)	<0.0001
	Confidence in being able to recognize as asthma attack	6.74 (2.54)	9.14 (1.00)	2.40 (1.78–3.02)	<0.0001
	Confidence in being able to manage an asthma attack	6.29 (2.71)	9.10 (1.07)	2.81 (2.20–3.42)	<0.0001
	Confidence in knowing how to implement the correct procedure for asthma first aid	5.90 (2.81)	9.10 (1.12)	3.21 (2.60–3.82)	<0.0001
	Confidence in correctly using a spacer device with a puffer	6.69 (2.97)	9.28 (1.24)	2.59 (1.93–3.24)	<0.0001
Training					
Face to Face	AFAKQ† score	9.64 (3.02)	12.04 (1.37)	2.40 (1.67–3.13)	<0.0001
	Confidence in being able to recognize as asthma attack	7.03 (2.16)	9.47 (0.60)	2.45 (1.88–3.01)	<0.0001
	Confidence in being able to manage an asthma attack	6.44 (2.71)	9.49 (0.63)	3.05 (2.34–3.77)	<0.0001
	Confidence in knowing how to implement the correct procedure for asthma first aid	6.36 (2.84)	9.62 (0.56)	3.25 (2.49–4.02)	<0.0001
	Confidence in correctly using a spacer device with a puffer	7.42 (2.77)	9.75 (0.52)	2.33 (1.62–3.03)	<0.0001

*The mean difference pre and post training was significant at $p < 0.005$.
†Asthma First Aid Knowledge Questionnaire.

management. A previous study [11] using the same Asthma First Aid Knowledge questionnaire has also demonstrated that an online training platform can lead to an increase in asthma first aid management knowledge, however the change in mean knowledge score (difference in score was 3.2) in that study post training was greater compared to the change observed in our study. This is likely due to the differences in the study participants who were university students in their final year in contrast to our study where participants were school staff. Our study adds to the body of literature and provides further evidence in support of leveraging digital technology in improving asthma first aid management knowledge among a key target population.

In our study, the largest increase in asthma management confidence score post training was observed in the domain of confidence in knowing how to

Table 3. Comparison of the changes in the mean scores for asthma first aid knowledge questionnaire (AFAKQ) and self-confidence in each intervention group.

Factors	eBook training group mean change (95% CI)	Face-to-face training group mean change (95% ci)
AFAKQ† score	1.94 (1.20 – 2.70)	2.40 (1.67 – 3.13)
Confidence in being able to recognize an asthma attack	2.40 (1.78 –3.02)	2.45 (1.88 – 3.01)
Confidence in being able to manage an asthma attack	2.81 (2.20 – 3.42)	3.05 (2.34 – 3.77)
Confidence in knowing how to implement correct procedure for asthma first aid	3.21 (2.60 – 3.82)	3.25 (2.49 – 4.02)
Confidence in correctly using a spacer device with a puffer	2.59 (1.93 – 3.24	2.33 (1.62 – 3.03)

†Asthma First Aid Knowledge Questionnaire.

implement the correct procedure for asthma first aid (mean change in score was 3.2). We acknowledge that an increase in confidence or knowledge in asthma first aid management post training may not translate to improvement in skills required for asthma first aid management [11]. Online educational training to improve knowledge and confidence coupled with simulation training to improve asthma management skills may help in sustained improvement in asthma first aid management knowledge and skills in school staff [13,14].

We have demonstrated that the increase in knowledge and self-confidence in school staff following eBook training was not different compared to the increase in school staff who received standard face-to-face training; this may have been due to sample size as this study was powered to detect a pre-post difference in a group rather than between groups. Previous studies have demonstrated that short educational sessions in the form of seminars and pamphlets designed for school staff can lead to an increase in asthma knowledge [15,16]. However, research suggests that school staff need substantial time outside of school time to acquire knowledge through capacity building trainings [17]. The eBook is a digital platform which can be accessed at a time convenient for school staff and our data suggest that the eBook can be used as an alternative to face-to-face training. This is particularly relevant for school staff unable to access face-to-face training due to their geographical location or for staff who prefer a self-paced and self-directed approach to asthma first aid management training. In addition, there is potential to provide a blended learning opportunity for staff offering the best elements of both face-to- face learning and up to date technology enabled learning.

One of the limitations of this study is that the eBook was designed to be completed in the participant's own time and we could not prevent contact between participants from the same school randomized to the other group (face-to-face training), thus creating the potential for bias due to a spillover effect. In order to minimize this risk, we sent the link for the eBook at the same time participants from the same school were attending the face-to-face training session. Additionally, the study participants completed online questionnaire immediately pre and post training minimizing researchers bias in data collection. School staff from only 46 schools participated from the 1262 schools that were initially approached. This may represent a selection bias as these schools and staff members are likely to be more interested and motivated to learn about asthma management. There was a larger dropout rate in the eBook group than the face-to-face group (22% vs. 14%) predominantly due to difficulty in accessing technology which continues to be an ongoing obstacle in implementing widespread technology enabled learning. Asthma First Aid is yet to be recognized as a formal training requirement and school staff often have competing professional development requirements. The Principals of the consenting schools were required to release their school staff for a three hour off site training if school staff were randomized to receive face-to-face training which contributed to large dropout rates. Although the off-site face-to-face training sessions were offered at various venues across the target school areas to enable staff to attend without having to travel long distances, the actual number offered in each area was limited due to the study team resources which may have been a hindrance to participation as well. This study focused on measuring the increase in asthma first aid knowledge and confidence in schools staff however we did not assess whether the training actually had an impact on long-term retention of knowledge. Further research is needed to investigate long-term retention of knowledge post training. As identified by Kew and colleagues (19), this would be an important next step for future research. However the eBook is an online

educational tool, which can be accessed at any time allowing staff to ongoing refresher asthma first aid management trainings. Additionally as we did not collect information regarding Indigenous status of the participating school staff or their ethnic backgrounds, we were not able to compare effectiveness of the eBook across different groups of school staff.

Conclusion

We have demonstrated that training of school staff using the Asthma First Aid Management in Schools eBook resulted in a significant increase in asthma first aid knowledge and self-confidence in managing an asthma attack and this increase was comparable to the increase due to traditional face-to-face training. Technology enabled learning may be substituted for face-to-face training for providing training on asthma first aid management in settings where human resources for health education are limited. Future research investigating the impact of an online educational training resource on asthma first aid management skills will help refine asthma first aid management training manuals for school staff.

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Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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