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Systematic Review

Identifying and assessing strategies for evaluating the impact of mobile eye health units on health outcomes

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Abstract

Objective: *To identify and assess strategies for evaluating the impact of mobile eye health units on health outcomes.*
Design: *Systematic literature review.*
Setting: *Worldwide.*
Participants: *Peer-reviewed journal articles that included the use of a mobile eye health unit.*
Main outcome measure(s): *Journal articles were included if outcome measures reflected an assessment of the impact of a mobile eye health unit on health outcomes.*
Results: *Six studies were identified with mobile services offering diabetic retinopathy screening (three studies), optometric services (two studies) and orthoptic services (one study).*
Conclusion: *This review identified and assessed strategies in existing literature used to evaluate the impact of mobile eye health units on health outcomes. Studies included in this review used patient outcomes (i.e. disease detection, vision impairment, treatment compliance) and/or service delivery outcomes (i.e. cost per attendance, hospital transport use, inappropriate referrals, time from diabetic retinopathy photography to treatment) to evaluate the impact of mobile eye health units. Limitations include difficulty proving causation of specific outcome measures and the overall shortage of impact evaluation studies. Variation in geographical location, service population and nature of eye care providers limits broad application.*

KEY WORDS: *eye health, health outcomes, impact, mobile eye health units, rural ophthalmology.*

Introduction

Mobile eye health units (MEHUs) have been employed since the 1950s to provide eye care services to remote populations where access is otherwise limited. Documentation for some of the earliest uses of mobile eye health units originated in Kenya and Canada.[1–5] Since then, their use has extended to the United States, Europe and Asia.[6–9] Existing literature details many anecdotal accounts of successful implementation of MEHUs in both urban and rural settings. Many aim to improve eye care access for resource-poor areas or segments of the population. Utilisation in screening programmes is also common and data collected have aided in epidemiological studies to identify prevalence of disease. While large-sized land vehicles (e.g. trucks or vans) are most often used, some MEHUs have used aircrafts or boats as their clinic vehicle.[10–13] Services delivered on MEHUs range from simple vision checks to minor surgeries.

While the use of MEHUs are increasing, their impact on the health outcomes of their service population is difficult to determine. This review aims to identify and assess strategies in evaluating the impact of mobile eye health units on health outcomes. This fundamental work is important in the development of a model to measure the impact of mobile clinics. Evaluations beyond anecdotal and descriptive audits are necessary to determine the value of mobile eye health units in health outcomes and resource allocation.

Methods

A systematic literature review was conducted to identify and assess strategies that have been used to evaluate the impact of mobile eye health units on the health outcomes of the population they service. Health outcomes include but are not limited to patient outcomes, satisfaction, service utilisation and resource distribution. For this review, MEHUs are defined by the following criteria:

1. The use of a mobile vehicle as the mode of transport for service provision, the vehicle must carry all necessary clinical equipment with or without in-built clinic capabilities;

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What is already known on this subject:
- *Mobile eye health units have been successfully implemented across the world in a variety of settings to provide eye care.*
- *Mobile eye health units are frequently used to improve access for resource poor areas or populations.*
- *Services offered range from screening for diseases, disaster relief and targeted disease specific treatment to orthoptics services, optometrics services, and comprehensive ophthalmological care.*

What this paper adds:
- *Identifying and assessing strategies of evaluating the impact of mobile eye health units on health outcomes.*
- *Strategies can be applied to existing mobile eye health units to assess the impact on health outcomes of service populations.*

2. The mobile clinic must be staffed by health care professionals who travel with or in the vehicle to provide outreach eye health services; and
3. Eye health services include preventative and curative eye health care, eye health services may not necessarily be the only services provided.

PubMed, MEDLINE, EMBASE and Cochrane were searched for journal articles indexed by 20 June 2016. Various combinations of search terms (Appendix 1) were used to capture all relevant studies due to variability in terms used to describe a mobile eye health unit in existing literature. Citation results were imported into an electronic reference management software (Endnote) which aided removal of duplicate studies and management of citations.

Studies were selected for inclusion if outcome measures were reported for assessing the impact, role or value of a MEHU on health outcomes. Studies were also selected for human participants of all patient types including adults and children from low, middle and high-income countries. Restrictions were not placed on study type, language of original article or area of service provision. Following the previous definition of a mobile eye health unit, some methods of mobile eye care provision were excluded including (i) outreach workers who use modes of transportation without equipment carrying or in-built clinic capacity (e.g. bicycles); and (ii) mobile medical teams or health workers who visit temporary or permanent clinic structures to provide services to a particular community (as existing infrastructure diminish the need to carry all necessary equipment). Notably, audits which do not include follow-up analysis or outcome measures were excluded.

Eligible studies were identified in a two-step fashion. Initial screening was based on title and abstract only and subsequent screening considered the full text. Studies with no abstract automatically progressed to screening of full text and where full text was not immediately available, reasonable effort was made to obtain physical or electronic copies or translations from various resources. Two authors (SF and IT) were involved with both steps of screening and disagreements were resolved through discussion with a third author (JM). Eligible full texts were then assessed. Specifically, outcome measures which reflected a measure of impact were identified and data extracted. Extracted data were compared across all studies and evaluated.

Results

The initial literature search yielded 677 articles. After exclusions, six eligible studies were identified. (Figure 1) Their study characteristics are summarized in Table 1. The range of eye care services offered by the mobile eye health units were diabetic retinopathy screening (three papers), optometric services (two paper) and orthoptic services (one paper). The strategies that reflect an assessment of impact can be grouped into two major categories measuring patient outcomes and service delivery outcomes. The specific outcome measures used in each study are summarised in Table 2.

Discussion

MEHUs are commonly used for the provision of eye care; however, there are limited studies evaluating their impact. Most published articles are narrative audit descriptions of the implementation of a MEHU, while few report on patient and/or service delivery outcomes.

Patient outcomes

Two diabetic retinopathy screening studies measured disease severity of patients. Hautala *et al.*[14] studied a 5-years period of operation and was able to compare disease severity data from year one against year five as an indicator of the impact of the mobile screening unit. Leese *et al.*[15] used measures such as detection and new referral rate of advanced retinopathy to

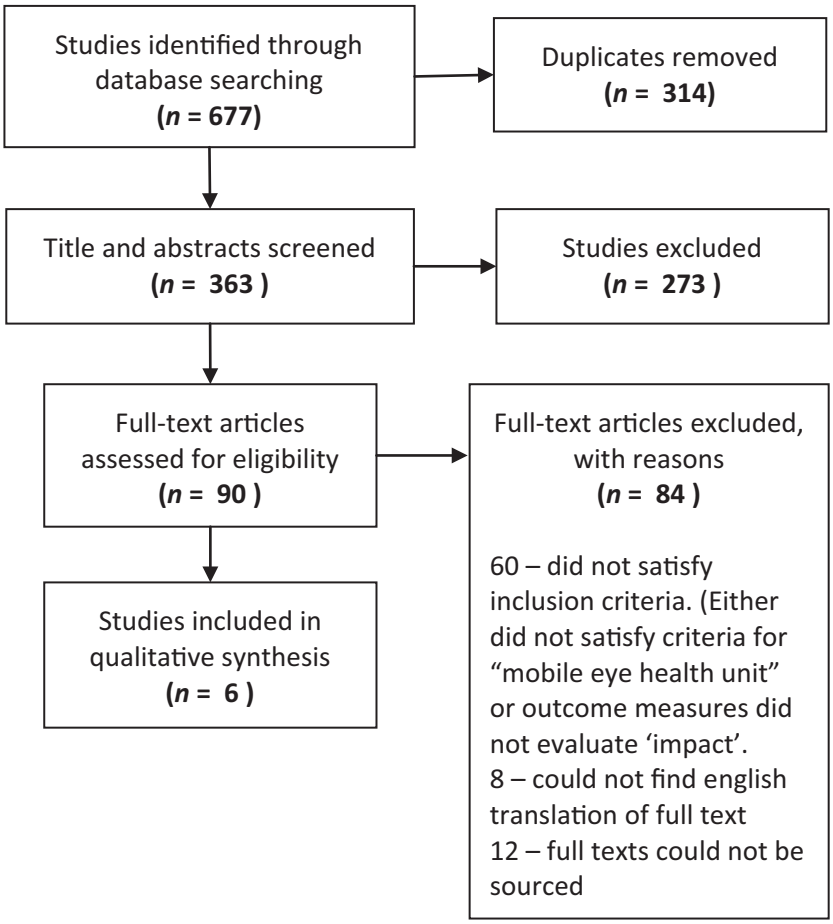

FIGURE. 1: *Schematic representation of the systematic review process.*

TABLE 1: *Study characteristics*

	Service location	Clinic vehicle (Name if applicable)	Health care staff	Eye care service offered	Length of operation evaluated
MacLellan & Harker (1979)[16]	Oxfordshire, UK	Mobile Caravan	Orthoptist	Primary vision screen in children	1 year
Leese *et al.* (1992)[15]	Tayside, UK	Non-descriptive Van	Ophthalmic photographer	Diabetic retinopathy screening	2 years
Lee *et al.* (2001)[18]	Victoria, Australia	Station Wagon	Imaging technician	Diabetic retinopathy screening	2 years
Hautala *et al.* (2014)[14]	Oulu, Finland	Mobile Caravan (EyeMo)	Imaging technician	Diabetic retinopathy screening	5 years
Alvi *et al.* (2015)[17]	Philadelphia, USA	Retrofitted bus (Eagles Eye Mobile)	Optometrist	Comprehensive optometry screen in children	2 school years
Lowry & de Alba Campomanes (2016)[19]	California, USA	Mobile Eye Examination Unit	Optometrist	Comprehensive optometry screen in children	3 school years

compare the impact of a MEHU between urban and rural populations. MacLellan & Harker[16] looked at detection of disease at the local eye hospital in the 4 years prior to the implementation of the mobile orthoptic unit and the effect the first year of the MEHU had on the trend of total squint and

TABLE 2: *Outcome measures used by studies to evaluate impact of mobile eye health units*

	Patient outcomes	Service delivery outcomes
MacLellan & Harker (1979)[16]	Disease detection Squint or amblyopia in children detected at local eye hospital compared to four previous years of data	Inappropriate referrals Number of children referred to local eye hospital where no abnormality was detected, as compared to four previous years of data Hospital transport use Number of children dependent on hospital transport for treatment of visual defect compared to previous years
Leese *et al.* (1992)[15]	Disease severity Detection of advanced retinopathy Rate of new referrals with advanced retinopathy Patients requiring urgent laser photocoagulation. Urban compared to rural population	Coverage Percentage of total population screened divided by the estimated prevalence of diabetes. Urban compared to rural population
Lee *et al.* (2001)[18]		Cost analysis Costs from a 2-year pilot programme were applied to a permanent model and the cost per participant was compared to the Medicare rebate cost for existing eye health services
Hautala *et al.* (2014)[14]	Vision impairment Incidence of visual impairment due to diabetic retinopathy in the area covered by EyeMo compared with other areas of Finland (using data from the Finnish Register of Visual Impairment) Disease severity Number of patients examined in EyeMo requiring treatment for progressive diabetic retinopathy and clinically significant macular oedema in year 1 compared to year 5 of operation	Coverage Percentage of all patients with diabetes in the area covered by EyeMo that attended a screening session. Percentage calculated annually and compared over time. Quality of Images Fundus images were evaluated for quality by independent authors and compared with fundus images taken in local municipal health care centres and the commercial service producer Delays to analysis and treatment The number of days from fundus photography to analysis by an ophthalmologist The number of days from fundus photography to treatment of diabetic retinopathy in hospital. EyeMo data compared with local municipal services and commercial service producers
Alvi *et al.* (2015)[17]	Compliance Percentage of children wearing prescribed glasses at 1, 4 and 12 months follow-up	
Lowry & de Alba Campomanes (2016)[19]		Cost analysis Decision analytic modelling comparing cost per case detected of referral to MEHU versus referral to community-based follow-up

amblyopia detected in children aged 0–14. Disease severity and detection measures reflect impact of disease screening vans, although study time frame would need to be long enough to see these changes reflected. It can also be difficult to prove direct causation. Changes in rate of disease detection and disease severity associated with a MEHU may be due to increased patient awareness or the variation in disease incidence in the population.

Hautala *et al.*[14] measured the level of visual impairment in the service population of the EyeMo over the 5 years of operation, and compared it with the level of visual impairment of the rest of Finland. This uses visual impairment as a snapshot of the eye health of a population at a point in time while using the rest of Finland as a control group. This outcome measure requires an adequate study period to evaluate impact of a MEHU over time.

The Eagles Eye Mobile (EEM) offered treatment (prescribed spectacles) on the mobile unit itself.[17] The study measured compliance of spectacle wear at 1, 4, and 12-months post initial consultation. They compared this with previous studies offering similar services from a stationary clinic. Once again, the limitation was the inability to directly attribute changing compliance rate to the form of service provision. In the study feedback from the teachers, it was in fact suggested that the high rate of compliance may be due to the connection of the EEM to a popular professional sports team.

Service delivery outcomes

All six studies reported on the efficiency and effectiveness of service delivery using various outcome measures. Leese *et al.*[15] and Hautala *et al.*[14] both reported coverage of the MEHU in terms of percentage of population that participated in the diabetic retinopathy screening, using an estimated prevalence of diabetes as denominator. Leese *et al.*[15] compared coverage between urban and rural populations, while Hautala *et al.*[14] assessed the change in coverage over time. The lack of comparison to coverage rate prior to implementing MEHU limits measures of service impact. Although both studies did not have a baseline coverage rate pre-MEHU, it is clear that coverage was an outcome measure that was used as a point of comparison to illustrate the impact of a MEHU either between different populations or the same population over time. Hautala *et al.*[14] also compared quality of fundus image and delays from time of photography to analysis and treatment to existing local municipal services and commercial services producer. MacLellan & Harker[16] report on the change in number of inappropriate referrals made to the local eye hospital after implementation of the MEHU, where the MEHU itself acts as another level of screening to filter out inappropriate referrals being made to local hospital. MacLellan & Harker[16] also measured the change in number of children dependent on hospital transport for treatment since the mobile orthoptic unit was employed. Depending on location, infrastructure and geographical characteristics, impact of a MEHU on transport requirements could be significant.

Cost-effective analysis has implications for resource allocation and government health care policies. Lee *et al.*[18] reported the cost per patient and compared it with the cost of other available methods of retinopathy screening. Lowry & de Alba Campomanes[19] also conducted cost-effective analysis reporting the cost per case detected and compared the cost of referrals to the mobile eye clinic as opposed to referrals to community-based eye clinics.

Implications for future studies

This review has found two categories of outcome measures used to evaluate the impact of mobile eye health units; patient outcomes and service delivery outcomes. Using these results, a recommended model for future studies is to use outcome measures from these two categories and add or subtract measures which apply to the specific MEHU being studied. For example, the Lions Outback Vision Van is a comprehensive MEHU launched in 2016 providing ophthalmological services

TABLE 3: *Theoretical outcome measures used to evaluate the impact of the Lions Outback Vision Van*

Patient outcomes	Service delivery outcomes
Disease detection (1)	Transport use (1)
Disease severity (2) (4)	Inappropriate referrals (1)
Visual impairment (4)	Coverage (2) (4)
	Patients seen
	Locations reached
Compliance (5)	Cost analysis (3) (6)
	Attendance rates
	Specialty services
	New equipment usage
	Additional clinical skills

(1) MacLellan & Harker (1979)[16], (2) Leese *et al.* (1992)[15], (3) Lee *et al.* (2001)[18], (4) Hautala *et al.* (2014)[14], (5) Alvi *et al.* (2015)[17], (6) Lowry & de Alba Campomanes (2016)[19].

Some measures have been used by previous studies to evaluate impact (as referenced). Other measures such as attendance rates and speciality services incorporate input from clinicians.

for regional and remote communities in Western Australia. A theoretical model to demonstrate application of the results of this review is shown in Table 3. Studies which have previously used these measures to evaluate impact have been inserted as references. These outcome measures could be compared before and after implementation of the MEHU. Attendance rates and specialty services are added measures recommended with input from practitioners working on the Lions Outback Vision Van. Measures such as quality of images or delays to treatment identified in this review may not be applicable or realistic measures for the Lions Outback Vision Van. Therefore, when choosing outcome measures for future studies that wish to evaluate the impact of a MEHU on health outcomes, it is important to choose outcome measures that are feasible within the proposed study design and are aligned with the research aim.

Conclusions

The impact of MEHUs is difficult to quantify. This review has found two categories of outcome measures used to evaluate their impact: patient outcomes; and service delivery outcomes. A major limitation for some of these outcomes is the difficulty in establishing causation to directly attribute improved outcomes to the intervention in question. The results of this study can be used by future studies wishing to evaluate the impact of a new or existing mobile eye health unit on health outcomes, but should consider the variable eye care services and widespread geographical distributions of the included studies.

Author contributions

SF, AT and JM developed the search strategy and eligibility criteria. SF and IT were involved in the screening process with JM as a third reviewer. SF extracted data and drafted manuscript. All authors read, provided feedback and approval for the final manuscript.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix 1. Search strategy.