What is the evidence for the clinical effectiveness and cost effectiveness of telemedicine in the context of paediatric unscheduled care (excluding neonates) in rural areas?

What is a scoping report
Scoping reports ascertain the quantity and quality of the published clinical and cost-effectiveness evidence on health technologies under consideration by decision makers within NHSScotland. They also serve to clarify definitions related to the research question(s) on that topic. They are intended to provide an overview of the evidence base, including gaps and uncertainties, and inform decisions on the feasibility of producing an evidence review product on the topic. Scoping reports are undertaken in an approximately 1-month period. They are based upon a high-level literature search and selection of the best evidence that Healthcare Improvement Scotland could identify within the time available. The reports are subject to peer review. Scoping reports do not make recommendations for NHSScotland. Further information on scoping reports is available at www.healthcareimprovementscotland.org

Key definitions
Telemedicine: The provision of healthcare over a distance using telecommunications technologies to provide live, interactive, audiovisual communications1,2.

Background
Medical emergencies in children are uncommon but when they do occur, there is a need for rapid action supported by effective communication to escalate the level of care often through transfer of the child to a more appropriate specialist care setting3,4. With around 18% of the population living in remote and rural settings, there are particular challenges in Scotland in providing safe and sustainable paediatric care. In 2009, there were 264,929 children aged under 16 years living in rural areas3.

Telemedicine can help address disparities in access to paediatric specialists. Incorporating video conferencing allows specialists to conduct visual examinations of patients and have a virtual presence with the child and their family as well as with the attending healthcare professionals. Organisational protocols, training, and availability and maintenance of equipment are important factors in the effective use of video consultations3. A single point of contact for referrals may improve the utility of the technology4. The use of telemedicine technology in the emergency department (ED) context has been shown to be as effective as in-person consultation in terms of diagnostic processes and treatment planning1.

A pilot project is trialing a dedicated on-call paediatric consultant model to provide 14 district general and community hospitals in rural Scotland, many of which are led by general practitioners, with access to a paediatric consultant 24 hours a day by video conference. The model aims to ensure that any paediatric emergencies have fast access to a specialist to support triage and ensure that the child receives the most appropriate care. The project is a partnership between five health boards and is facilitated by the North of Scotland Planning Group. A single point of contact is provided by NHS 24 and a call-handler facilitates the contact. Prior to the pilot project, there were a wide variety of protocols in place for hospitals to contact paediatric specialists and this was normally telephone based.

The Centre for Rural Health of the University of Aberdeen are conducting an evaluation of the pilot project and outcomes of interest include speed of specialist response, rates of patient transfer to specialist centres, rates of short duration admissions to specialist centres, and healthcare provider and family satisfaction with the technology and with the quality of care.
The following questions were scoped:

1. What is the evidence for the clinical effectiveness of telemedicine in the context of paediatric unscheduled care (excluding neonates) in rural areas?

2. What is the evidence for the cost effectiveness of telemedicine in the context of paediatric unscheduled care (excluding neonates) in rural areas?

Literature search

A search of the secondary literature was carried out between 16 and 25 October 2013 to identify systematic reviews, health technology assessments and other evidence-based reports. Medline, Medline in process and Embase databases were searched for systematic reviews and meta-analyses.

The primary literature was searched between 11 and 12 November 2013 using Medline, Medline in process and Embase databases. Results were limited to English language. No date limits were applied due to the relatively recent emergence of the technology.

Concepts used in all searches included: paediatrics, remote consultation, telemedicine and telehealth. A full list of resources searched and terms used is available on request.

Evidence base

Table 1 Included evidence sources

<table>
<thead>
<tr>
<th>Publication type</th>
<th>Number of publications</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort study</td>
<td>3</td>
<td>2, 3, 7</td>
</tr>
<tr>
<td>Cost effectiveness study (conference abstract)</td>
<td>1</td>
<td>8</td>
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Findings

1. What is the evidence for the clinical effectiveness of telemedicine in the context of paediatric unscheduled care in rural areas?

Three observational studies were identified. All are from the United States (US) and the applicability to the Scottish context is likely to be limited by the fact that the rural hospitals are larger, and may have staff who are more specialist than those in rural Scotland. For outcomes which involve transfer rates, the nature of the healthcare funding system in the US may also limit applicability.

One study compared process outcomes following specialist paediatric consultations provided from an academic children’s hospital paediatric intensive care unit (PICU) to EDs at five rural hospitals in Northern California between 2003 and 2008. The rural hospital EDs had 4,000 to 10,000 visits annually and between 10 and 30 visits annually by critically ill children.

Outcomes associated with patients, identified retrospectively, who had telemedicine consultations (n=58, consecutive) were compared with those who had telephone consultations (n=63, consecutive) or no specialist consultations (n=199, quota sampled). The mean age of the children was 6 years. Consultations were sought at the discretion of the physicians. Analysis focused on consultations for those children who were seriously ill or injured with life- or limb-threatening injuries requiring immediate physician assessment. The time taken for each consultation was not provided.

Quality of care was assessed from medical records by two independent reviewers using a five-item scoring instrument developed by the authors. Each item attracts between one and seven points classifying aspects of care from ‘extremely inappropriate’ to ‘extremely appropriate’. When adjusted for age, severity of illness and year of consultation, mean overall quality of care item score difference for telemedicine consultations compared with no consultations was 0.50 points higher (95% confidence interval (CI) 0.17 to 0.84, p<0.01). The score difference for telemedicine consultation cases compared with telephone consultations was 0.38 points higher (95% CI 0.00 to 0.77, p=0.05). The clinical significance of these findings is unknown.

In a survey of the referrer doctors within 24 hours of the consultation, responses were recorded for all 68 telemedicine consultations sampled but only for 16 of the 27 telephone consultations (59.3%). The proportion of patients where there was perceived to be change around diagnosis (47.8% versus 13.3%, p<0.01) or around therapeutic intervention (55.2% versus 7.1%, p<0.01) was higher with telemedicine consultation compared with telephone consultation, as was the proportion of patients...
where there was a change in planned disposition, for example, admission or transfer (37.7% versus 20.0%, p<0.01). Again, the clinical significance of these differences is unknown.

In a survey of parents by questionnaire offered at time of discharge for postal submission, there were responses for 48 of 68 telemedicine consultations (70.6%) and all 27 of the telephone consultations. Satisfaction score for overall ED experience was higher with telemedicine compared with telephone consultation (6.37 versus 5.33, p<0.01).

In a linked study from the same care network (identified subsequent to the literature searches), rates of physician-related ED medication errors were compared following telemedicine consultations (n=73, consecutive), telephone consultations (n=85, random sample) or no specialist consultations (n=76, random sample) in children with mean age 5.2 years from eight rural hospitals between January 2003 and December 2009. Analysis focused on consultations for those children who were seriously ill or injured with life- or limb-threatening injuries requiring immediate physician assessment. Medication errors were identified and classified from retrospective review of medical notes conducted independently by two paediatric pharmacists using a tool developed by the authors. The tool examined errors around medication selection, dose and route of administration. The overall rate of medication errors was 8.8%, around half of which was accounted for by dose errors. For telemedicine consultations, the rate was 3.4%, for telephone consultations 10.8% and for patients receiving no specialist consultation 12.5%. After adjusting for age, risk of admission, year of consultation and hospital, the odds ratio (OR) for medication errors in patients who had telemedicine consultations was 0.13 (95% CI 0.02 to 0.74) when compared with no specialist consultation. This was a statistically significant reduction (p<0.05). The corresponding OR associated with telephone consultations was 0.82 (95% CI 0.25 to 2.67).

The third study described 63 paediatric critical care telemedicine consultations over a 2-year period to March 2008, between EDs of 10 rural hospitals in upstate New York and Vermont and a tertiary PICU in the region. The staffing mix of the rural hospital EDs varied and there was a range of staff numbers from 2 to 26 (mean=9). The mean age of patients was 4 years and 2 months, and respiratory distress or failure was the most common primary diagnosis. There were 236 specific clinical recommendations made by the specialist paediatricians. In 61 cases, transfer to the tertiary centre (mean distance 75 miles) was recommended. Unnecessary transfer was avoided in one case and one patient died before transport. Unnecessary endotracheal intubation was avoided in 12 patients. Many of the clinical recommendations of the specialists were supported by direct observations such as asymmetrical chest rise post-intubation, abdominal distension and poor skin perfusion. These would not have been available by telephone. Technical difficulties were experienced in 29% of the consultations. In a questionnaire survey, intensivists recorded that for 89% of the consultations they would agree or strongly agree that the consultation improved the quality of health care for the patient. The corresponding figure for the referring providers was 88%.

2. What is the evidence for the cost effectiveness of telemedicine in the context of paediatric unscheduled care in rural areas?

One study from the US, published as a conference abstract, was identified which compared the cost effectiveness of critical care telemedicine consultations to children presenting at eight rural EDs with asthma, bronchiolitis, dehydration, fever, or pneumonia with the cost effectiveness of telephone consultations. A probabilistic cost-effectiveness analysis using Monte Carlo Simulation was carried out for each diagnosis with the rate of transfer of patients to a more specialist level of care providing a measure of effectiveness. Costs were derived from an inpatient database. A societal perspective was adopted. Telemedicine was more effective at reducing transfer rates (39.4% transfers avoided compared with 12.5% transfers avoided with telephone consultations). For a willingness-to-pay to avoid one transfer of $10,000 (approximately £6,000), telemedicine was more cost effective for 74% to 87% of the cohort. The full report of this study was not available for appraisal.
Summary

This rapid review of the published literature focused specifically on studies which reported on the use of telemedicine to link generalist practitioners and paediatric specialists in the context of paediatric unscheduled care in rural areas. Only three studies were identified. These small observational studies reported data from two care networks in the US. Comparisons were made between the use of telemedicine and telephone for consultation among healthcare providers treating critically ill children at rural EDs and paediatric specialists. When compared with telephone consultation, telemedicine consultations were associated with higher scores on measures of the quality of care processes such as data gathering, integration of information to develop a diagnosis, and treatment planning. Telemedicine was also associated with more frequent changes in proposed diagnosis and proposed treatment plans and with fewer medication errors, particularly around dose. No data were identified to indicate the clinical significance of these findings in improving patient outcomes. Telemedicine consultations allow direct observation to support specialist recommendations around care or treatment decisions and, for most cases, clinicians surveyed in one study recorded that the quality of health care is improved by the consultation. In a survey of parents, satisfaction with the overall ED experience was higher for telemedicine than telephone consultation.

The applicability of the studies to the Scottish context is likely to be limited by differences in healthcare systems and in patient characteristics such as the severity of illness.

Only one cost-effectiveness study was identified. This was from the US and was published as a conference abstract reporting that telemedicine consultations help to reduce transfer rates and are likely to be more cost effective than telephone consultations for children with asthma, bronchitis, dehydration, fever, or pneumonia.

Further work for Healthcare Improvement Scotland

No further work is anticipated for Healthcare Improvement Scotland.

Equality and diversity

Healthcare Improvement Scotland is committed to equality and diversity in respect of the nine equality groups defined by age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion, sex, and sexual orientation. As a scoping report summarises information and does not provide recommendations a full equality impact assessment is not deemed necessary.

The scoping report process has been assessed and no adverse impact across any of these groups is expected. The completed equality and diversity checklist is available on www.healthcareimprovementscotland.org
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Healthcare Improvement Scotland invited the following individuals and organisations to peer review the draft technologies scoping report:

Dr Leila Eadie, Research Fellow, Centre for Rural Health, University of Aberdeen, Independent topic reviewer

Professor Pat Hoddinott, Chair in Primary Care, Nursing, Midwifery and Allied Health Professions Research Unit, University of Stirling, Independent topic reviewer

Dr Lucy Thompson, Senior Research Fellow, Centre for Rural Health, University of Aberdeen, Independent topic reviewer

Declarations of interest were sought from the clinical advisor and all peer reviewers. All contributions from peer reviewers were considered by the group. However the peer reviewers had no role in authorship or editorial control and the views expressed are those of Healthcare Improvement Scotland.

Lorna Thompson, Lead Author/Health Services Researcher

Paul Cannon, Information Scientist

Susan Downie, Medical Writer

Emma Riches, Medical Writer

Marina Tudor, Team Support Administrator

Members of the SHTG evidence review committee

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NICE has accredited the process used by Healthcare Improvement Scotland to produce its evidence review products. Accreditation is valid for 5 years from January 2013. More information on accreditation can be viewed at www.nice.org.uk/accreditation
References


