



# In what circumstances is telemedicine appropriate in the developing world?

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## DECLARATIONS

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## Summary

**Objectives** To review papers reporting actual experience with telemedicine in developing countries and to summarize their findings, including the strength of the evidence.

**Design** A retrospective review was conducted. Study quality was assessed.

**Setting** Four commonly-used electronic databases.

**Main outcome measures** Study quality scores.

**Results** From a total of 202 potential articles, 38 relevant papers were identified. Thirty-four articles (89%) reported clinical experience and 14 articles (37%) reported the use of telemedicine for educational purposes. The quality of the reports was rather weak (median quality-score 3, on a scale 0–9); only one study, rated at 7, fell into the high quality score band. The fact that almost all studies reported positively in favour of telemedicine suggests a publication bias. Of the 38 articles, 15 (39%) reported the use of real-time telemedicine and 25 (66%) reported the use of asynchronous, or store-and-forward, telemedicine. Email was the most commonly reported modality (half of all studies).

**Conclusion** Some of the longer established telemedicine operations have developed into substantial networks. The review suggests that great potential exists for telemedicine in the developing world. However, some caution is required in future telemedicine work if telemedicine exemplars are to be produced which can be widely copied.

## Introduction

Telemedicine is the practice of medicine at a distance. It generally relies on some kind of telecommunication technology, such as the Internet or a satellite link. The primary advantage of telemedicine is improved access to healthcare, and since the developing world is characterized by

continuing difficulties with access to healthcare, it might be presumed that telemedicine would be of value in developing countries (Box 1). However, despite many years of small-scale pilot trials, there has been little adoption of telemedicine for routine healthcare delivery.

Is telemedicine, therefore, appropriate in the context of the developing world? After all, there

assistance with the  
literature search

**Reviewer**  
Jonathan Collins

### Box 1

#### Telemedicine and its potential

##### *What is telemedicine?*

The literal meaning is 'medicine at a distance'. This covers the situation where patient and healthcare worker are in different places, and where the interaction may concern diagnosis, treatment/management, or education. Approximate synonyms include telehealth, telecare, e-health, etc.

Most doctors will routinely contact colleagues for advice by telephone or email during their normal working day. This is a basic form of telemedicine, even if it is not always recognized as such. Thus, telemedicine is a wide-ranging concept for something that is already done regularly by doctors. The difference between this individual practice and a telemedicine *system* lies in the structure or the organization of the network. Such concepts are not new: the Italian radiomedical network to support ships at sea (Centro Internazionale Radio Medico) was created in 1935 and is still in operation today.<sup>29</sup>

##### *Why is telemedicine worth considering in developing countries?*

Telemedicine deserves consideration because of the real needs of developing countries for healthcare access. There is also the ethical imperative of trying to obtain the best possible healthcare in a resource-constrained environment. Now that worldwide satellite communication is available at reasonable cost, telemedicine can be used in many different ways such as improving healthcare access, supporting health workers in isolated settings or addressing the shortage of specialist doctors. Telemedicine thus works toward the concept of only one class of medicine, which transcends boundaries.

is an opportunity cost attached to its use: if resources are expended on telemedicine, then they are not available for other, well-proven health measures, such as TB and HIV programmes, the Extended Programme of Immunization (EPI) or improved nutrition. That is, unless the value of a telemedicine project is known to be greater than conventional alternatives, then it represents a waste of resources. (In this context, 'value' probably means cost-effectiveness.)

This is more than just a theoretical argument. There have been some spectacular and costly failures with telemedicine in developing countries. For example, the South African government tried to implement a national telemedicine system in the 1990s.<sup>1</sup> More recently, the Malaysian government also attempted to implement a national system – that project cost US\$5.5 million and only a few hundred cases were handled before it was withdrawn for 're-planning'.<sup>2</sup>

The present study, therefore, addressed the Research Question: in what circumstances is telemedicine appropriate in the developing world? There appear to have been no previous reviews

which explicitly address this topic. Thus the aim of the present review was to obtain a better understanding of the circumstances in which telemedicine is useful and sustainable in the developing world.

## Methods

We conducted a literature search to identify papers reporting experience with the use of telemedicine in developing countries. The primary objectives were to explore, with reference to developing countries: (1) what practical experience with telemedicine has been reported? (2) for what purposes has telemedicine been used? (3) are the reports generally positive? (4) what questions does this experience raise? (5) what are the current research challenges?

The search was framed according to the following PICOS components: (1) the population being addressed was that of the developing world (P); (2) the interventions of interest were any telemedicine applications (I); (3) the comparators were formal control groups in experimental studies (C); (4) the main outcome of interest was quantitative or qualitative evidence of effectiveness (O); and (5) the study designs chosen were not proscribed in advance (S).

We searched the following databases: Medline, Embase, Cinahl and HMIC (Health Management Information Consortium) from 1990, using the search terms listed in the Appendix to identify papers reporting telemedicine usage in developing countries.

We screened the papers and excluded those that did not have an abstract and those that were not published in English. We reviewed the abstracts and further excluded papers that did not report the actual use of telemedicine, i.e. we excluded editorials, thought pieces, reviews, etc.

Data were extracted from the full text of the remaining articles independently by the two authors using predefined data fields, including study quality indicators. Differences were resolved subsequently by consensus.

## Study quality

We are not aware of any previous attempt to measure study quality in telemedicine work in developing countries, so no pre-existing, validated scale was available. The quality of the studies was scored on five criteria, based on those used in previous

studies on other telemedicine topics (Table 1). The overall quality score was the sum of the scores of the individual items and ranged from 0 to 9. The interpretation of the overall score is:

0–3 Poor quality. The study findings cannot be relied upon;

4–6 Fair quality. Some limitations of the study may affect the interpretation of the findings;

7–9 High quality. There is a high degree of confidence in the study findings.

## Results

The literature search produced a total of 202 potential articles. Duplicates were eliminated and the records were screened before assessing them for eligibility in accordance with the exclusion criteria. After this process, a total of 38 articles

remained which reported actual experience with telemedicine in developing countries (Table 2). The process is summarized in a PRISMA diagram (Figure 1). Of the 38 articles, 34 (89%) reported clinical experience and 14 (37%) reported the use of telemedicine for educational purposes. Of the 38 articles, 15 (39%) reported the use of real-time telemedicine and 25 (66%) reported the use of asynchronous, or store-and-forward, telemedicine. Email was the most commonly reported modality (half of all studies).

The number of patients involved in clinical work, or the number of subjects involved in educational work was not always stated explicitly. Where stated, the median number of patients/subjects was 58 (range 1–783), but it was clear that in some studies, there were several thousand.<sup>3,4</sup> The number of developing countries involved ranged from 1 to 58. All studies except one concluded positively in favour of telemedicine. However, only 8 studies (21%) contained a reflective passage about lessons learned.

No papers had been published before 2000. There was no obvious trend in the rate of publication of papers (Figure 2).

## Study quality

The majority of the studies ( $n = 26$ ) were experimental, while the remainder ( $n = 12$ ) were observational in nature. Only three studies employed a control group.<sup>5–7</sup> Only two studies conducted a formal cost measurement,<sup>8,9</sup> although another nine studies made a cost estimate. Only four studies made a formal assessment of effectiveness,<sup>5,8,10,11</sup> although another 14 made an estimate of effectiveness.

The overall quality scores ranged from 0 to 7 (Figure 3). The median score was 3. Only one study, rated at 7, fell into the high quality score band.<sup>8</sup>

## Discussion

### Principal findings

The present study shows that telemedicine has been used in the developing world in broadly similar ways to its use in industrialized countries. That is, primarily for educational and clinical purposes. It also shows that the quality of the reports is rather weak, as assessed by criteria commonly used in reviews. Furthermore, the fact that

**Table 1**

### Assessment of study quality

Criterion	Question	Scoring
1. Size	How many patients were provided with the telemedicine service (if clinical)? Or how many recipients were provided with the telemedicine service (if educational)?	0 = not stated; 1 = 1–50; 2 = 51–500; 3 = >500
2. Type of study	Did the authors introduce a telemedicine intervention, i.e. was it an experimental study? Or did the authors review an existing intervention, i.e. was it an observational study or a descriptive report?	0 = observational; 1 = experimental
3. Use of control group	In the case of an experimental study, was a control group employed?	0 = no control group; 1 = control group
4. Assessment of costs	Was the cost of telemedicine (and where applicable, the alternatives) measured or was it estimated?	0 = no; 1 = estimated; 2 = measured
5. Assessment of effectiveness	Was the effectiveness of telemedicine (and where applicable, the alternatives) measured or was it estimated?	0 = no; 1 = estimated; 2 = measured

**Table 2**  
**Studies assessed**

<i>Study</i>	<i>Type of report*</i>	<i>Type of work†</i>	<i>Type of telemedicine‡</i>	<i>Modality§</i>	<i>Developing countries (n)**</i>	<i>Sites (n)††</i>	<i>Study conclusion‡‡</i>	<i>Overall study quality§§</i>
Adebayo 2006 <sup>30</sup>	O	O	N/A	Internet, Web	1	N/A	N/A	2
Allen 2007 <sup>3</sup>	O	C	S	Web	5	6	+ve	3
Ayyagari 2003 <sup>31</sup>	E	C, E	R	V/C (ISDN/ satellite)	1	5	+ve	3
Bagayoko 2006 <sup>32</sup>	O	E, C	R, S	Web/VSAT	12	30	+ve	2
Chantada 2008 <sup>33</sup>	E	C	R	Internet discussion/ conferences	19	58	+ve	3
Cooke 2000 <sup>34</sup>	O	C	S	Email	39	21	+ve	3
Dodani 2008 <sup>5</sup>	E	E	R	V/C	1	2	+ve	6
Geissbuhler 2003 <sup>35</sup>	E	E, C	S, R	Web, V/C (Satellite)	1	4	+ve	1
Geissbuhler 2007 <sup>14</sup>	O	E, C	S, R	Web, Web conferencing (Satellite)	10	?11	+ve	0
Graham 2003 <sup>36</sup>	E	C	S	Email	1	2	+ve	3
Johnston 2004 <sup>8</sup>	E	C, E	R	V/C (ISDN)	1	2	+ve	7
Kiviat 2007 <sup>37</sup>	O	E	R	Web	7	10	+ve	0
Kvedar 2006 <sup>38</sup>	E	C	S	Email, Web	1	2	+ve	4
Latifi 2006 <sup>39</sup>	O	E, C	S	Internet: Email, Web conferencing	1	8	+ve	1
Lee 2003 <sup>40</sup>	E	C	S	Email	1	2	+ve	4
Martinez 2007 <sup>9</sup>	E	C	R, S	Email (VHF radio)	1	39	+ve	2
Mukundan 2003 <sup>41</sup>	E	C	S	Email	1	2	+ve	3
Ozuah 2004 <sup>4</sup>	O	C, E	R	V/C (Internet, Satellite)	58	N/A	+ve	3
Patterson 2001 <sup>42</sup>	E	C	S	Email	1	2	+ve	3
Patterson 2007 <sup>43</sup>	E	C	S	Email	26	N/A	+ve	5
Person 2003 <sup>44</sup>	E	C	S	Web	2	3	+ve	4
Pradeep 2006 <sup>45</sup>	E	C	R	V/C (ISDN, Satellite)	1	2	+ve	2
Pradeep 2007 <sup>46</sup>	E	E, C	R	V/C (ISDN, Satellite)	1	2	+ve	3
Qaddoumi 2007 <sup>10</sup>	O	C	R	V/C (ISDN)	1	2	+ve	5
Rashid 2003 <sup>6</sup>	E	C	S	Email	1	2	+ve	4
Rezailashkajani 2008 <sup>47</sup>	E	E	S	Web	1	N/A	+ve	4
Sekar 2007 <sup>48</sup>	E	C	R	V/C (Satellite)	1	2	+ve	3
Skalet 2008 <sup>7</sup>	E	C	S	Email, Web	1	6	+ve	4
Swinfen 2002 <sup>49</sup>	O	C	S	Email	5	12	+ve	0
Swinfen 2003 <sup>50</sup>	E	C	S	Email	9	19	+ve	4
Thara 2008 <sup>51</sup>	E	C	R	V/C (ISDN)	1	8	+ve	3
Vassallo 2001 <sup>52</sup>	O	C	S	Email	3	6	+ve	3
Vinals 2005 <sup>53</sup>	E	E, C	S	Email, Web (ADSL)	1	3	+ve	4
Wootton 2003 <sup>54</sup>	E	C	S	Email	3	9	+ve	2

(Continued)

**Table 2**  
**Continued**

<i>Study</i>	<i>Type of report*</i>	<i>Type of work<sup>†</sup></i>	<i>Type of telemedicine<sup>‡</sup></i>	<i>Modality<sup>§</sup></i>	<i>Developing countries (n)**</i>	<i>Sites (n)<sup>††</sup></i>	<i>Study conclusion<sup>‡‡</sup></i>	<i>Overall study quality<sup>§§</sup></i>
Wootton 2004 <sup>55</sup>	E	C	S	Email	1	2	+ve	4
Wootton 2009 <sup>11</sup>	E	C	S	Email, Web	12	25	+ve	4
Zbar 2001 <sup>56</sup>	E	C, E	S	Web	6	7	+ve	4
Zolfo 2006 <sup>57</sup>	E	C, E	S	Email, Web	17	N/A	+ve	3

\*O = observational (i.e. a descriptive report); E = experimental (e.g. there was a control group which did not receive the intervention)

<sup>†</sup>C = clinical, A = administrative, E = educational, O = other (e.g. a research study). Note that studies could fall into more than one of these categories

<sup>‡</sup>Type of telemedicine used, i.e. R = real-time, S = store-and-forward, H = hybrid

<sup>§</sup>Modality of interaction (e.g. videoconferencing (V/C), email, web) and means of telecommunication (e.g. satellite, Internet, VHF radio link)

\*\*Number of developing countries involved

<sup>††</sup>Number of sites in the network. Note that there will be at least two, e.g. the referring site and the expert site. Where the expert site coordinates referrals on behalf of a large number of experts located in different places (e.g. the SCT), the expert site is counted as a single location

<sup>‡‡</sup>Did the paper report positively in favour of telemedicine?

<sup>§§</sup>Overall score for study quality (see text)

almost all studies reported positively in favour of telemedicine suggests a publication bias. Based on theoretical considerations, Ioannidis concluded that the smaller the studies conducted in any scientific field, the less likely the research findings are to be true; the greater the flexibility in their designs, definitions, outcomes and analytical modes, the less likely the research findings are to be true; and the greater the financial interests and prejudices, the less likely the research findings are to be true.<sup>12</sup> These matters seem apposite to much of information technology, but especially to telemedicine, which is bedevilled by continual changes in terminology and technology, by commercial interests and by hyperbole from interested parties.

### Education

The present review shows that educational work has been in the form of distance learning, either of an asynchronous nature (e.g. self-study via the web) or interactive (e.g. videoconferencing). An example of asynchronous education is the WHO Pacific open-learning network, which provides online courses and health information to health professionals in the Pacific Island countries.<sup>13</sup> An example of real-time education is the interactive web-casting employed by the Réseau Afrique

Francophone de Télémedecine organization (RAFT) for countries in French-speaking Africa.<sup>14</sup>

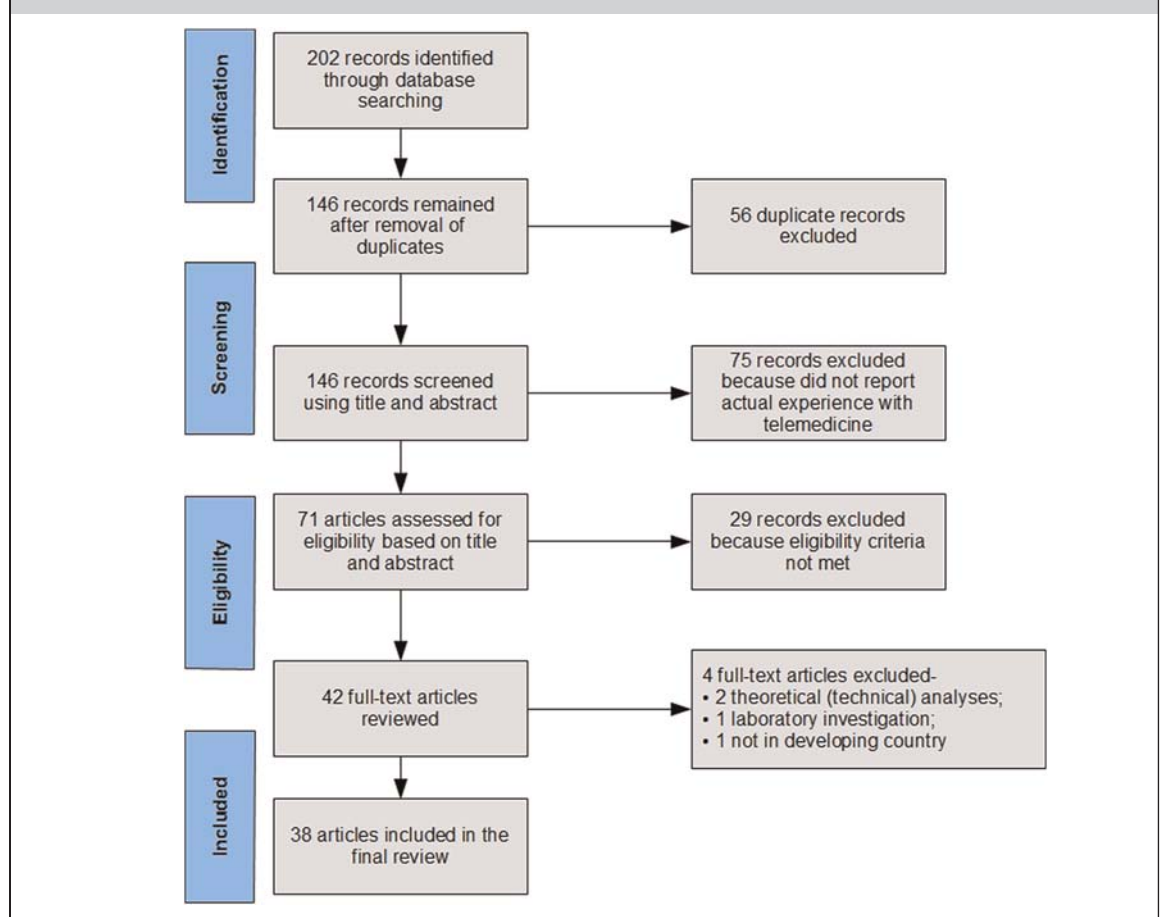
There seems to be limited formal evidence of the educational value of telemedicine, although this is a comment which might be made in respect of the industrialized world as well. Where it has been evaluated, telemedicine seems to be a cost-effective method of facilitating distance education.<sup>15</sup>

### Clinical

The use of telemedicine for clinical purposes is rather different. The clinical work that has been performed so far has been predominantly to obtain second opinions by those working in a wide range of medical and surgical fields, including general practitioners. Often, ordinary email is used to obtain specialist advice from consultant colleagues in other countries. Some of the longer established operations have developed into substantial networks.<sup>16</sup> Telemedicine has also been used on a more limited basis to provide direct access to a first opinion in specific specialties, such as ophthalmology<sup>7</sup> or paediatric neuro-oncology.<sup>10</sup>

In addition to the second-opinion work, there has been some use of telemedicine following disasters (either natural or man-made). This has attracted considerable publicity, although there

**Figure 1**  
**PRISMA flow diagram. PRISMA is Preferred Reporting Items for Systematic Reviews and Meta-Analyses**  
 (see <http://www.prisma-statement.org/>)



have been few evaluation reports. The experience of those attending disasters is that the first priority is to provide physical support to the population and to local health workers – triage, primary and emergency care – rather than virtual support through telemedicine.<sup>17</sup> In such situations, useful telemedicine applications are likely to be similar to those employed in accident and emergency departments<sup>18</sup> with one important difference: following a disaster, health workers have to contend with chaos, with disrupted communications, damaged infrastructure of all kinds, and the non-availability of human resources. That is, in disaster areas, everything is disorganized, disrupted and systems of communication have collapsed. However, this may provide a possible role for telemedicine in the future, if new mobile

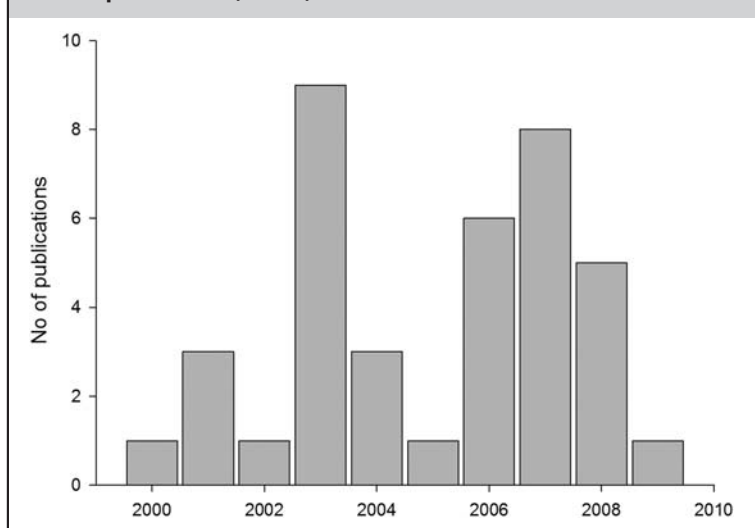
technologies can provide emergency communication networks.<sup>19</sup>

### Strengths and weaknesses

We are not aware of previous reviews of telemedicine in low-resource settings in which study quality has been assessed. A strength of the present study, therefore, is that it represents original work in this area.

The positive findings in the studies reviewed suggest publication bias. However, a limitation of our study was its restriction to electronic databases, and to English-language articles. To confirm publication bias it would be necessary to widen the search in order to identify unpublished, negative articles, e.g. by searching the 'grey' literature. It is

**Figure 2**  
Year of publication ( $n = 38$ )



also known that selecting only English-language papers can produce results which are different from those based on papers from all language groups.<sup>20</sup>

### Strengths and weaknesses in relation to other studies

Despite some limitations, the present overview provides a good picture of the wide range of

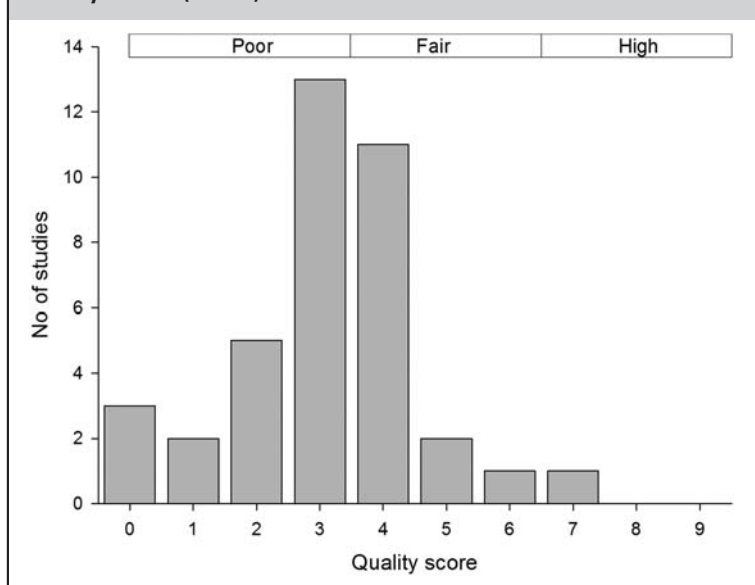
telemedicine applications used in developing countries, even if their lack of focus weakens the evidence base. Very few of the studies reviewed have been conducted with high methodological quality and we, therefore, make a strong call for more rigorous methodological assessment in future, along well-defined guidelines. For example, cost-effectiveness is a fundamental aspect of the introduction of telemedicine and our review found very few studies which had addressed this topic.

### Implications for clinicians and policymakers

Most of the reported work on telemedicine usage in developing countries concerns pilot trials or feasibility studies. Based on the work identified in the review, supplemented by some others, studies providing guidance include:

- (1) the use of email for primary healthcare in the Amazon jungle. This Peruvian telemedicine network is based on email transmission by VHF radio link. A recent study has documented fewer urgent patient transfers from health posts and health centres<sup>21</sup> and there is emerging evidence for cost-effectiveness;<sup>9</sup>
- (2) the use of mobile phones in TB and AIDS, particularly in Africa. Mobile phones appear to provide a low-cost method of improving adherence to treatment;<sup>22</sup>
- (3) the large-scale use of electronic records. In Rwanda, electronic medical records are used to support HIV and TB treatment<sup>3</sup>; in the Czech Republic, over one million people now own an Internet-based personal health record, to which they grant their doctors access. A recent cost-benefit study of the IZIP system shows that it provides significant economic benefits to the participants;<sup>23</sup>
- (4) the use of low-cost email for second opinions in the developing world. Organizations such as Partners Healthcare in Boston and the Swinfen Charitable Trust (SCT) in the UK have been providing such services for many years (Box 2). No information has yet been published about the economics, but the SCT has recently published on patient follow-up.<sup>11</sup> Other applications aim to improve access to specialized medicine and have been also successfully tested particularly in the areas of

**Figure 3**  
Quality scores ( $n = 38$ )



specific disease screening, such as for retinopathy of prematurity.<sup>7</sup>

#### Plan of action

If a telemedicine proposal is not guided by one of the examples above, then it is essential that it is evaluated, so that others can learn from the experience. An evaluation will probably entail measuring performance, including cost-effectiveness. This is likely to mean conducting some kind of comparison with a control group. Having conducted an evaluation, the results must be published. This is important because unless the results of *all* trials are published, publication bias will ensue, i.e. the integrity of the overall body of scientific knowledge, and ultimately the safety of future patients, will be jeopardized.

It is also worth noting that the usual objections that are raised against evaluation in telemedicine (e.g. that it is too expensive, takes too long, is too difficult) can all be countered. It might require perseverance, but telemedicine is not so intrinsically complex that it cannot be evaluated by a randomized controlled trial or by a study combining both quantitative and qualitative approaches.<sup>24</sup> Indeed, telemedicine has been around for a long time now, and a good deal is known about the factors in successful implementation. So even if the telemedicine proposal is truly novel, it should be possible to make an intelligent guess about how to implement it in the setting in question – this is just another way of saying: do not repeat previous mistakes!

#### Box 2

##### Swinfen Charitable Trust

The Swinfen Charitable Trust is a UK-based charity that provides low-cost telemedical assistance, e.g. advice on difficult cases, to doctors working in developing countries. Since 1999, second opinions and management advice have been provided by Internet-messaging to doctors at more than 100 hospitals from a total of 35 different, resource-poor countries. The expertise is donated by volunteer specialists from Australia, the UK and the US (mainly). At present, there are more than 400 consultants from about 100 different specialties and subspecialties.

Over the last 10 years, telemedical advice has been provided for nearly 2000 patients. Experience has shown that successful telemedicine is possible in a wide range of medical, nursing and allied health specialties – even neurology is possible by email. Surveys have shown that the referring doctors find the advice helpful, that it improves the management of their patients, and that outcomes can also be better.<sup>11</sup>

Since it contains case reports which reflect useful clinical experience, the system also has important educational value.

#### Unanswered questions and future research

##### Ethical

A central ethical question concerns the potential use of telemedicine in the absence of robust evidence for cost-effectiveness. There are certainly areas of telemedicine in which reasonable evidence for cost-effectiveness does exist, albeit almost always in the context of the industrialized world.<sup>25</sup> Where the developing world is concerned, we believe that there are few easy answers and that considerable caution is required. Wasting resources in healthcare is, of course, unethical both in developing and industrialized countries, but from an utilitarian point of view it is particularly unethical in places which have very few resources. The consequences of wastage that will have little effect on healthcare in industrialized countries can have profound impact in low-resource settings.

This may also be relevant in disaster work, where there have been few evaluation reports about telemedicine. Following the Armenian earthquake in 1988, a satellite link was established between medical teams in Armenia and doctors in the US and Russia. The satellite link (called a 'space bridge') permitted the transmission of fax data, as well as audio- and videoconferencing for teleconsultations.<sup>26</sup> The major unanswered question in respect of this telemedicine operation – and others subsequently – is whether the resources employed (e.g. telecommunications, equipment, personnel) might have produced a bigger health gain if they had been used in different, perhaps more conventional ways.

##### Technical

Other questions concern the technical standards to be employed in telemedicine. Existing standards for image-transfer, for example, are based on those of the industrialized world. Is an email service based on digital photographs of X-rays (which would not meet international standards) unacceptable ... or is some service better than none at all? What are the ethical implications of lowering standards?<sup>27</sup> If reduced technical standards are accepted, will this actually lead to a lower standard of healthcare in a resource-constrained environment? Is the automatic acceptance of first-world technical standards simply a waste of money?



### The wider perspective

A fundamental aspect of telemedicine is that it encourages 'medicine without borders'. That is, the medical interaction can work in both directions. Properly, we should consider telemedicine as an exchange between doctors working at the same level, but working in different environments. Medical practice in developing countries is not under-developed medicine, rather it is medicine in a different environment with restricted means. In this situation, the knowledge and clinical experience of consultants can add something that may improve patient management in isolated settings, and may contribute to the education of the referrer. However, the consultants may benefit as well: the experience of the SCT shows that consultants frequently see more florid pathology via telemedicine than is common in their own practice, and often request permission to use the material for teaching purposes. On a larger scale, HIV treatment with three anti-retroviral drugs in a single tablet was pioneered in developing countries;<sup>28</sup> single-tablet treatment is now a standard method of reducing the pill burden and increasing adherence in the industrialized world.

### Conclusion

This article is based on our own reflections and experience with the use of telemedicine in the developing world, but draws on a review of the subject generally. Our conclusion is that great potential exists for telemedicine in the developing world. A back-of-the-envelope calculation suggests that all of the second opinion networks currently operating are servicing only about 0.1% of the potential demand from the developing world.<sup>16</sup> And of course there are many more areas of use than simply obtaining a second opinion. As shown above, by facilitating links and collaborations between doctors working in developing and industrialized countries, telemedicine can stimulate innovation in both directions.

The literature review suggests that for people considering telemedicine applications in the developing world, the optimum way to proceed should be:

- (1) avoid proposing very large and expensive projects;
- (2) ensure close collaboration with local doctors, national health services or NGOs working in

- the field. If people working in the field are not intimately involved, any healthcare project is doomed to failure. The involvement of local staff is essential if an assessment of real needs and priorities is to be made in the local context;
- (3) take into account the published experience of others;
- (4) start small, and build evaluation into the pilot stage;
- (5) publish the evaluation results, whether positive or negative;
- (6) scale up only on the basis of clear success.

Failing to follow this line is not likely to produce telemedicine exemplars which can be widely copied. Instead there is the risk of inappropriate use of scarce resources, which in healthcare carries unfortunate ethical implications.

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## Appendix 1 Literature search strategy

The following headings were combined with the term 'developing countries'.

### Medline

Telemedicine (Explode to include the headings Telepathology and Teleradiology)  
 Videoconferencing  
 Telemetry  
 Remote consultation  
 Internet (e-health maps to this heading)

### Embase

Telemedicine (Explode to include narrower terms Telecardiology, Teleconsultation, Teledermatology, Telemonitoring, Telepathology, Telepsychiatry, Teleradiology, Teleradiotherapy, Telesurgery, Teletherapy)  
 Telehealth  
 Telemetry (Explode to include narrower term Telephone telemetry)  
 Telenursing  
 Internet (e-health maps to this heading)

### Cinahl

Telemedicine (explode to include narrower terms Telepathology, Teleradiology, Remote consultation, Telenursing, Telepsychiatry)  
 Telehealth  
 Telemetry  
 Videoconferencing  
 Teleconferencing

### HMIC (Health Management Information Consortium)

Telemedicine  
 Telecare  
 Telemetry  
 Videos  
 Internet

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