Rural mobile network coverage is an issue for the NHS

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Royal College of General Practitioners, Scotland
Royal College of Physicians and Surgeons of Glasgow
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The Sandpiper Trust
Scottish Board, College of Emergency Medicine

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Summary

- “It would really transform our working lives and patient safety here” (Orkney GP).

- A modern reliable mobile phone network across remote and rural Scotland would benefit the NHS in terms of improved quality of healthcare and reduced costs. The use of phone, camera, video and computer technology can enhance the delivery and sustainability of locally delivered care with savings in time and costs involved.

- Rural General Practice includes aspects that differ from urban service provision particularly in relation to emergency care. The role is challenging with recruitment and logistics difficulties. Communications is a key issue.

- There is an expanding range of uses for mobile phone technology in medicine with innovative uses in transmitting an ECG or as a means of improving patient compliance in chronic disease management. Mobile phones offer many advantages that would be of particular benefit in rural areas.

- eHealth offers potential benefits to the NHS in terms of efficiency but appears to concentrate on broadband delivered service. Whilst the relevance of apps is mentioned very little of the focus appears directed at remote and rural areas.

- Mobile network provision has been commercially driven and concentrated on urban areas. The existing 2G footprint excludes many remote and rural areas and the 3G network even more so. Without a concerted effort to improve rural coverage a digital divide will be established.

- The EMRS catchment area was surveyed for 2G coverage. Some 34 of the 66 centres covered have no network providing a good level of cover. This presents recurrent difficulties for NHS service delivery in these areas.

- Existing rural communications are a patchwork of disjointed networks with NHS staff using multiple mobile phones, pagers and non-UK tariffs in an attempt to secure reliable service.

- There are a range of options to improve on the current situation. From the simple provision of WiFi and signal boosters at NHS premises to supporting local network improvements and arguing for changes in the means of service provision.

- Mobile phone technology addresses the key dimensions of the Quality agenda in health. Specifically equity of service with urban areas to improve patient care and reduce NHS costs is vital. The NHS should argue for improved rural mobile network coverage in order to improve service and reduce costs.
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1. Introduction

The role of the mobile phone network in medicine is increasingly recognised and network provision is generally taken for granted in urban areas. Network coverage in remote and rural areas is often poor and results in an impaired service for patients and increased NHS costs. There are a range of potential means to improve on the current situation, the NHS should recognise the importance of ensuring good network coverage and actively pursue these means to secure improvement where coverage is currently absent or poor.

2. Rural GP

Aspects of the GP role differ widely between urban and remote rural areas (1). A recent BMJ Careers article notes; “because of the distances from hospital, the range of services provided tends to be wider. Rural practitioners need to provide emergency care, and in some remote areas they may have to manage critically sick or injured patients for a number of hours before these patients can be transferred. To allow patients to remain near their family and to avoid long and arduous journeys there is a need for home or community based services such as palliative care or rehabilitation. Many remote and rural areas have community hospitals, and in some areas GPs run acute hospitals that provide emergency and inpatient care with remote tertiary support” (2).

The role in managing critically ill patients, both medical and trauma cases, whilst arranging transfer to definitive care, is particularly challenging. Distances between emergency hospitals, on-call cover for adjoining single-handed practices, tourists as patients and transport issues including ferry timetables and the impact of the weather on transport are all issues. Recruitment and particularly out-of-hours cover for remote General Practices can be problematic and many rural areas have concerns regarding emergency ambulance provision (3 – 13).

The challenges of NHS provision in remote and rural areas have been extensively reviewed and reliable communication is a key factor in such areas with lengthy travel times and scarce resource in making optimal use of services. This is particularly important for those involved in prehospital care such as BASICS-Scotland schemes (14–19).
3. EMRS

The Emergency Medical Retrieval Service (EMRS) is a critical care transfer team which covers remote and rural areas of west and north Scotland (20). The service provides critical care support to a range of NHS facilities;

a) Six ‘Rural General Hospitals’ (RGH) which have limited consultant staffing and no intensive care units (Oban, Fort William, Stornoway, Wick, Orkney and Shetland) (21)
b) 15 GP community hospitals. We include only those which admit emergency cases and are more than an hour’s travel from a major hospital. This group includes sites such as Arran, Islay or Barra hospitals.
c) 33 ‘isolated GP practices’, those more than an hour from a hospital admitting emergencies. This includes sites such as Colonsay, Bunessan or Hillswick
d) 12 ‘isolated Nurse Practitioners’, sites where a nurse practitioner is more than an hour from a GP. This group includes sites such as Kilchoan, Fetlar etc.

The total of 66 facilities ranges from Stranraer in Galloway, to Unst in Shetland, across seven different health boards.

EMRS makes considerable use of mobile technology. The service has an iPhone app for team members which carries logistic information regarding the catchment area, transport options, standard operating procedures (SOPs) etc. The app won a recent ‘Technology for healthy outcomes’ prize (22).

Referrals to EMRS are put through to the mobile phone of the duty consultant, this and subsequent calls in completing a transfer can often run to 20+ calls;

- referral
- call to ambulance control + airdesk re transport options
- if overnight a call to the on-call second member of the team
- if overnight / fixed wing a call to the heliport / airport to confirm flight arrangements
- multiple calls to find an appropriate bed for the patient (depends on triage, ICU bed availability etc.)
- additional calls where further specialist equipment needed, blood transfusion etc.
- update to referring doctor before departure
- update from referring to receiving site
- further calls re. logistics arrangements / complications / delays etc.
- feedback calls (to receiving and referring centres) 24 hours later

Particular difficulties arise where the rural sites have no mobile coverage. Liaison between the EMRS team and both referring and receiving centres can be difficult and this duty team is effectively ‘out of contact’ with EMRS base and colleagues regarding further referrals or unexpected difficulties. For some sites where the landing site and hospital are several miles apart and especially where different agencies (ambulance and SAR) use different landing sites (in opposite directions!) this can present problems. Patient transfers often require changes of logistics, equipment, means of transport, destination etc. and lack of mobile coverage can seriously frustrate communications in a complex situation.
4. Mobiles and medicine

There is an evolving body of evidence highlighting the multiple potential roles of mobile phones in modern health care (23). Smartphones present a versatile combination of functions for phone, camera, video and computer technology. Many of these are particularly relevant to remote and rural areas where distance and travel time are of great importance.

1) A study from Oxfordshire showed reduced mortality at scene and a reduced total mortality rate where initial emergency calls were made via mobile phones rather than via landlines (24).

2) It is increasingly recognised that telephone-advised CPR has a role in out of hospital cardiac arrests. “Telephone-advised CPR has been included in the 2010 RC(UK) Guidelines because:.....the wide availability of mobile phones makes it likely that there will be a phone available at the site where the victim has collapsed” (25).

3) A study in an urban centre showed a significantly reduced response time to cardiac arrest cases where mobile phone technology was used to alert nearby lay responders (26). As a potential extension of the ‘first responder’ concept in remote and rural areas with sparse ambulance resource this may well be of greater benefit in these areas rather than in urban centres?

4) The value of prehospital photos in subsequent patient assessment, particularly in determining mechanism of injury in road traffic collisions, has long been recognised. Where the original studies used instant cameras for ubiquity and ease of use these have been largely superseded by smartphones (27).

5) Similarly mobile phone photos can be used in initial assessment of burns, ENT emergencies, dermatology cases or extremity trauma. (28 – 31).

6) Smartphones can assist provide background information (from apps) and calculator function required for drug prescribing (32).

7) ECG. In the US the FDA has licensed ‘Smartheart’, an ECG device which transmits, via Bluetooth, to a phone for forwarding and further review (33, 34). Potentially this and similar such devices would offer not only much greater ease of portability than for example standard ECG machines but the ability to arrange remote review far more readily, to improve decision-making and triage.

8) Reducing complications. It is recognised that improved management of long-term conditions in the community setting can reduce the need for hospitalisation (35). Likewise it is recognised that rural patients have greater issues with access to healthcare, poorer uptake of screening etc. and for example in the case of diabetes, more likely to have advanced diabetic retinopathy (36, 37). Smartphone technology offers the potential to further simplify the screening process, reducing the need for patients to attend multiple distant hospital appointments and enabling local, health centre or even home based review (38 – 41).
9) Compliance. The role of mobile phones in improving patient compliance continues to develop but includes smoking cessation, tuberculosis, HIV as well as completion of vaccination regimes and clinic attendance (42 - 46).

10) Video. The use of smartphones and video technology is expanding with a number of programmes available (47, 48). Whilst such technologies may not yet be medical mainstream the potential is there to further reduce the need for ‘face to face’ review and open opportunities for health centre or home based consultation with a hospital centre (49).

Fundamentally just as telemedicine represents a move away from the need for a patient to travel to a hospital setting so mHealth (the use of mobile technology in health services) may represent the next step in making care more patient-centred by using technology to bring a greater array of services to the patient on an even more local basis (50).

In terms of likely impact on NHS costs;

- A more rapid response to emergencies should minimise complications
- Improvement of initial assessment with the provision of more accurate data should reduce the need to transfer borderline cases and allow a clearer determination of those cases that can be treated in primary care
- In improving the management of chronic illnesses this should reduce the incidence of emergencies which require hospital admission (diabetes, asthma etc.) which from rural areas can necessitate lengthy emergency transfers
- Improved compliance in treatment of infections (or uptake of vaccinations) may reduce spread of disease and
- Reducing the non-attendance rate at clinics should improve the efficacy of patient review and the functioning of outpatient clinics.
- NHS Western Isles has recently shown considerable savings by using computer-based video technology – including reduced cancellations, a 30% reduction in consultant travel costs etc. (51)

Much of the coverage of the use of mobile phones in medicine focuses on negative aspects, potential interference with critical care equipment, security and privacy issues and infection (52 – 54).

Whilst not ignoring the concerns above, it is clear that mobile phones and smartphones in particular offer a range of advantages that patients in remote and rural areas have potentially the most to gain from. The positive aspects of mobile phone technology in health care include reducing the need for lengthy travel to hospital and particularly the need for emergency transfers. All is dependent on there being reliable network provision in the rural area. Network provision is a significant issue for the NHS and lack of network incurs additional costs in direct patient care. Poor rural phone signal will deprive rural communities of these advantages and add to NHS costs.
5. eHealth

The use of information technology (IT) to aid the delivery of healthcare is now an accepted goal of the NHS. IT offers the potential to increase efficiency, improving communication, reducing delays waiting for notes or the amount of printing, improving access to information etc.

NHS Scotland has a detailed eHealth strategy, focussing on benefits and outcomes rather than technology and linked to the quality strategy (55, 56). eHealth stresses; efficient working practices, communication, management of chronic conditions, availability of information and medicines safety. Undoubtedly eHealth strategies have begun to show results, PACS (picture archiving and communication system) means radiology films can be viewed digitally and no hurried scramble to collect all the x-rays before transferring a patient. The use of a national CHI number, secure NHS email and the ‘emergency care summary’ (ECS) are all contributing to less stressful exchange of information.

Similarly NHS Wales ‘Informing healthcare’ and in England the Department of Health (DoH) ‘the Power of Information’ have IT strategies and goals to smooth the flow of information in the NHS (57,58)

The DoH also has an extensive and impressive NHS Mobile Working Centre detailing the challenges and opportunities presented by utilising technology to embrace mobile working “Mobile working is the ability to work anywhere, irrespective of place and time, enabling staff to access and update information and communicate on the go. In the context of community health services mobile devices provide community clinicians with real time access to valuable resources at the point of care. Critical activities can now be completed more efficiently in real time.... Mobile working also provides clinicians with the means to better manage their time and workload. They can communicate more freely with colleagues and patients, and have the flexibility to work in the office, in the community or at home. It's also an opportunity for the organisation to modernise, develop more streamlined service models and make better use of valuable resources.” (59, 60)

Interestingly nowhere in either the Welsh or English documents is the word ‘rural’ used. The Welsh IT strategy uses ‘remote’ only twice – both in reference to ‘performance management and not in the ‘very rural’ sense. The English document has one use of ‘remotely’.

The English strategy makes repeated (seven) mentions of the use of apps. as a means of making information available in a modern health service with increasing use of smartphones.

The Scottish eHealth strategy does have 12 mentions of ‘remote’ or ‘rural’ but no mention of apps. however a recent radio debate in Scotland included comment from a spokesperson for the Scottish Centre for Telehealth and Telecare that anticipates more widespread use of apps by the NHS (61, 62)

Many of the various initiatives focus on services using the broadband network but there appears to be an underlying assumption that the mobile phone network is universally available. Nowhere in the ‘Mobile Working Centre’ is there concession that mobility may be seriously disadvantaged by lack of any network. Apps may offer great advantages in terms of information accessibility but again with no network availability the functionality is greatly limited. Failure to address the paucity of coverage in remote and rural areas will lead to a two-tier provision of digital services excluding those populations in areas with a poor mobile service.
6. Coverage

Existing network coverage is described by a number of means (63);
- for an operator to be counted as having coverage, its network footprint has to cover at least 90% of the postcode district
- signal strength should be sufficient to make or receive a call outdoors
- coverage is quoted as ‘% of premises’ or as ‘% of geographical area’
- Thus an area is deemed ‘covered’ when e.g. 90% of premises have an outdoor signal.

What is important is where people would want to use mobiles – only 15% of households lack a fixed phone line. The true value of a mobile is largely when away from home but usage would be minimal in the most truly remote areas. The areas between these extremes are where mobiles would be most useful. Thus ‘coverage’ of premises (i.e. 90% within the postcode) may exclude large sparsely populated areas, highways etc, particularly in remote and rural areas. A figure somewhere between the ‘% premises covered’ and ‘% geographical cover’ may give a better indication of effective mobile network coverage?

Across the UK in 2011, 96.8% of premises were assessed as having a 2G signal from all operators and 73.1% of premises as having a 3G signal from all operators (for Scotland the figures are 94.5% and 63% respectively) (64).

For rural areas the coverage figures are much lower (Table 1.)

Table 1. UK Mobile network coverage 2011 (65)
Coverage from all (four) networks by local authority

<table>
<thead>
<tr>
<th></th>
<th>2G</th>
<th></th>
<th>3G</th>
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<tbody>
<tr>
<td></td>
<td>premises</td>
<td>area</td>
<td>premises</td>
<td>area</td>
</tr>
<tr>
<td>Argyll &amp; Bute</td>
<td>70</td>
<td>17</td>
<td>3</td>
<td>&lt;1</td>
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<tr>
<td>Highland</td>
<td>77</td>
<td>22</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Orkney</td>
<td>61</td>
<td>40</td>
<td>&lt;1</td>
<td>&lt;1</td>
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<td>Shetland</td>
<td>40</td>
<td>8</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Western Isles</td>
<td>39</td>
<td>14</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Glasgow</td>
<td>99</td>
<td>99</td>
<td>98</td>
<td>95</td>
</tr>
</tbody>
</table>

Commercially driven network provision will inevitably focus on the ‘low-hanging fruit’ and risk excluding less populated areas. Using 2001 census data and a UK population of 59 million, 1% equals 590,000 people. The total population of the EMRS catchment area on 2001 census data is 245,000. Even with 99% UK coverage the entire population of the EMRS area could remain excluded from cover.

In the 2009 consultation ‘Mostly Mobile’ Ofcom considered ‘commercially-driven 2G may have reached its limit’ with 2G coverage at that time available to 99% of UK population (66).

The terms of UK 3G licences have recently been revised to stipulate that by mid-2013 ‘at least 90% of the UK population’ must be covered (up from the previous 80%) (67).
In October 2011, the UK Government announced the Mobile Infrastructure Project (MIP) with £150m in capital expenditure to improve mobile coverage and quality. The objective being to extend coverage to 99% of the UK population, coverage difficulties in rural areas were highlighted (68).

In June 2012 Vodafone and Telefónica (O2) announced increased network collaboration and pledged ‘to close the digital divide between rural and urban areas, targeting 98% indoor population coverage across 2G and 3G by 2015’ (69)

The concept of a developing urban-rural digital divide has been cited with resulting exclusion of remote and rural areas (70). Universal connectivity is increasing taken for granted in an urban environment but lack of even 2G network in rural areas can have significant adverse impact on commercial, tourist and educational activity as well as the health-related advantages mentioned earlier.

As 3G cover continues to expand to fill the existing 2G footprint pressure is mounting to develop a 4G network (71).

Failure to address the paucity of coverage in remote and rural areas will lead to a two-tier provision of digital services excluding populations in areas with no network access. There is a significant risk that those areas which lie outside the current 2G network will be permanently marginalised and face digital exclusion from many aspects of society that urban-dwellers take increasingly for granted.
7. Survey.

As a result of repeated difficulties with mobile connectivity across the EMRS catchment area a survey was undertaken to ascertain the level of mobile network coverage.

Methodology.
A four stage approach was adopted;

i) For each of the 66 NHS facilities in remote and rural areas that EMRS takes referrals from, the postcode was noted and the population covered by facility was established (72).

ii) The network coverage maps were assessed for the level of 2G (voice and text) coverage shown for the postcode of each of the 66 sites (73). Coverage was assessed as ‘good’ / ‘moderate to poor’ / ‘none’.

iii) An email based survey was conducted. For each of the 66 sites NHS personnel (a mixture of consultants, GPs, nurse practitioners and area managers) were emailed a covering letter and a short survey. The recipients were asked which mobile network they use and to assess network coverage on the same good / moderate to poor / none scale as above for four aspects;

1) At their place of work, what reception is there;
   a) for phone and text services (2G)
   b) for apps. video and internet (3G)

2) For the wider catchment area of the hospital / practice, what reception is there;
   a) for phone and text services (2G)
   b) for apps. video and internet (3G)

The survey also requested any additional comments regarding local coverage issues for the facility concerned.

The results of stages (ii) and (iii) were combined with the results of the email survey regarded as stronger evidence than that of the network coverage maps as they reflect real life experience of consumers. Those areas which do not have ‘good’ coverage from any network were then prioritised as determined by; type of facility (RGH > Community hospital etc.), level of cover (no coverage being worse than ‘moderate or poor’) and population covered by the health facility.

iv) For those sites which have no ‘good’ coverage from any network the local mast locations as shown on the Mobile Phone Base Station Database were reviewed to see if this suggested any evident means of improving coverage (74)

Results.

- Network coverage maps suggest that 28 of the 66 health facilities in the EMRS catchment area have no mobile network providing ‘good’ 2G coverage.
- Survey responses were received from 74% of the centres.
The responses to the email survey suggest that the network maps are a little ‘optimistic’ in some areas and would add another seven centres to those with no good network coverage.

One centre that the network maps suggested as having poor coverage was reported as having ‘good’ 2G coverage! This centre was removed from the final list.

The combined results identifying 34 facilities which lack ‘good’ coverage from any network are shown in Table 2, prioritised by level of facility > level of coverage > population covered.

<table>
<thead>
<tr>
<th>Site</th>
<th>Mobile network 2G coverage @ site</th>
<th>Pop.</th>
<th>Health Board</th>
<th>Level of facility</th>
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<tr>
<td></td>
<td>Vodafone O2 EE Three</td>
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<tr>
<td>1 Arran</td>
<td></td>
<td>5,058</td>
<td>A&amp;A</td>
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<tr>
<td>2 Barra</td>
<td></td>
<td>1,172</td>
<td>WI</td>
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<td>3 Golspie</td>
<td></td>
<td>9,866</td>
<td>Highland</td>
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<td>4 Portree, Skye</td>
<td></td>
<td>7,169</td>
<td>WI</td>
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<td>5 Benbecula</td>
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<td>4,857</td>
<td>WI</td>
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<td>6 Walls</td>
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<td>680</td>
<td>Shetland</td>
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<td>7 Yell</td>
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<td>8 Bunessan</td>
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<td>9 Sanday</td>
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<td>10 Glenelg</td>
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<td>28 Fetlar</td>
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<td>30 Out Skerries</td>
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<td>34 Lismore</td>
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Table 2. Health facilities with no network providing ‘good’ mobile reception
Key to Table 2.

<table>
<thead>
<tr>
<th>No network coverage</th>
<th>Abbreviations of Health boards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor / moderate coverage</td>
<td>A&amp;A = NHS Ayrshire &amp; Arran</td>
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<tr>
<td>On an island</td>
<td>WI = NHS Western Isles</td>
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<tr>
<td>EE = Everything Everywhere = Orange + T-mobile</td>
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For each of the 34 sites above the location of nearby masts was reviewed in an attempt to identify any options to improve coverage. Options for each site, in the same order of prioritisation and with postcode and telephone contact for each, only the first two sites are given as examples;

1  **Arran** (Lamlash WMH), KA27 8LF, 01770 600777.
   a) *There is an Airwave mast to the south of the village (NS 024296) @ 105 m above sea level, sharing (mast or site) should provide good coverage to the whole village?* or,
   b) *There are many public buildings in Lamlash which could site a mast but it is closely mixed with residences, or*
   c) *A mast in the King’s Cross area may offer coverage to Whiting Bay as well?*

2  **Barra**, St. Brendan’s Hospital, Castlebay, HS9 5XJ, 01871 812021
   The island has split coverage with Vodafone in the less inhabited N and W and Orange around Castlebay.
   a) *There is an Airwave mast to the SE of Castlebay*
   b) *There is an Orange mast to the W of Castlebay*
   *Sharing site / mast of either may improve hospital coverage?*

In very broad terms there are three groups of options that emerge;

1. For 14 of the 34 sites an arrangement to share a local Airwave mast / site may be an option to improve coverage. This would offer improved coverage for the emergency health care of 60% of the total population covered by the 34 sites.

2. Many of the islands have airport facilities and for 11 of the 34 centres provision of a mast at the airport would improve reception

3. For many of the centres small populations and difficult terrain make it difficult to argue that new mast provision would be realistic. In 19 of the 34 centres some form of femtocell option (open / closed, building / settlement specific) may be the best option? (75 – 78)

The above are not exclusive – for several centres there are multiple potential options. For some of the larger centres a business case could be constructed for mast provision – particularly if tourist numbers or transport roles are considered.
The additional comments made about local coverage issues give an insight into the impact on the NHS in rural areas including;

“Patients and their families also suffer huge difficulties communicating with relatives, taxis, ferry company etc, as though being held ‘incommunicado’ while trying to make complex travel and social arrangements” (GP Arran).

“It would really transform our working lives and patient safety here” (GP Orkney).

The additional comments from the survey are included as appendix 1.

There are limitations to the above;

a) Only those centres covered by EMRS have been considered. This excludes rural GPs within one hour of an emergency hospital etc. There may be many other rural GPs with poor reception but critically ill cases would likely be referred from the local hospital.

b) The email survey achieved response from 74% of centres, for the rest the only evidence is from network coverage maps.

c) The Ofcom Sitefinder is no longer updated for Everything Everywhere sites (Orange + T-mobile) (74)
8. Rural communications

The results of the survey, in particular the additional comments from rural NHS staff, reveal a picture far from the ‘universal connectivity’ model of 21st century eHealth.

In addition to highlighting the many centres that have no network that provides ‘good’ reception the survey reveals frequent issues with landline and broadband services and concerns regarding the delays experienced in rural areas for these to be repaired.

Given that rural general practices can cover very large areas, the impact for on-call service provision is considerable. Several GPs cited the difficulties in being contacted when on-call, clearly long distances in ‘notspots’ mean long periods of time with difficulty contacting the on-call doctor.

The practical difficulties are further illustrated by considering the mix of devices used to contact NHS staff;

1) **Multiple mobiles.** Several GP practices have catchments which include more than one area of ‘single network’ cover but by different networks. In the absence of any ‘roaming’ arrangements for rural areas our colleagues carry more than one mobile, each effective in only part of the area! (survey responses).

2) **Pagers,** several areas still make use of this technology. With a few exceptions these systems have been superseded by mobile phones (US paging industry revenue decreased from $6.2m in 2003 to $2.1m in 2008, Orange closed its UK pager network in 2001) (79, 80). Essentially rural colleagues are having to persist with dated technology due to lack of reliable phone network coverage.

3) **Non-UK providers.** One creative way of working round patchy cover from multiple networks and the lack of roaming arrangement between UK networks has been to use phones from non-UK providers which then allow roaming between UK networks (as they treat UK networks as ‘abroad’ – not using their own domestic network) (81). Whilst ingenious and a potential improvement in terms of 2G phone services this has potential to be very expensive in terms of data roaming charges, perhaps a partial answer for phone / text contactability but problematic for full smartphone capabilities? (survey responses)

4) **Airwave.** A number of rural GPs, particularly those involved in prehospital responses, have Airwave radios which appear to have much more reliable coverage in rural areas (82, 83).

The lack of mobile network coverage has a real and direct financial cost to the NHS in rural areas, costs for additional mobiles for complementary patches of network coverage, pager systems, non-UK mobiles, all add up to a fractured, incomplete and expensive service.

Even in simple financial terms the lack of rural network provision should concern the NHS are there would be real savings in improved coverage. On these grounds alone the NHS should be proactive in attempting to secure improved network coverage for rural areas.

There are a range of potential options which would improve mobile phone services in remote and rural areas. These form a spectrum from potentially ‘immediate / practical / relatively inexpensive’ to ‘major / structural / unlikely’ options.

a) **Immediate practical options.** These measures can be taken in the short-term to improve reception at the health facility itself.

- The use of local **WiFi** networks at a health facility would give access to some of the functions provided by a 3G network. Medical care makes increasing use of apps. both directly medical and transport or weather related apps may be relevant in rural areas (for planning transfer logistics etc.). WiFi would enable updating of apps and allow the transfer of files to mobile phones (e.g. local protocols) which can then be accessed offsite. With support from local NHS IT departments it should be possible for most facilities to set-up a secure WiFi system, it would provide some functionality but limited ‘mobility’ of technology as it is location specific.

- On certain networks WiFi can be used to boost mobile phone performance. This requires a particular range of handsets and a pre-identified WiFi network (84). Usually considered as a means to boost ‘home’ coverage this could theoretically be used to improve coverage at a work site.

- **An alternative means of boosting mobile performance using a broadband connection is by means of a closed femtocell** (75, 76). This requires a minimum 1 MB broadband speed and boosts the mobile signal. It is said to work even where no mobile signal is otherwise found! A ‘femtocell’ is simply a much smaller base station than a conventional mast, in this context usually providing a ‘single building’ network, a range of around 10m cf a standard mast range of several kilometres. ‘Closed’ signifies that the mobile numbers able to use this must be pre-programmed into the cell, up to 32 in one model with 4 phones able to use the cell simultaneously. This may provide some additional benefits to WiFi with basic ‘phone and text’ functions in addition to the updating of apps and file transfer supplied by WiFi. Again local NHS IT departments may be able to organise this.

b) **Mid-range options.** These measures would require working closely with other local agencies to improve coverage, the NHS locally and nationally should take an active role in this.

- There are currently ongoing trials with **open femtocells** (77, 78). These may have the advantage of providing a wider range of cover, possibly ‘settlement specific’ rather than ‘building specific’ (100m range in earlier trials) and not requiring that the numbers of mobile handsets able to use the cell must be pre-programmed into the cell. Two of the current 12 trial sites are in Scotland at Walls and Hamnavoe, both in Shetland. General availability of open femtocells will depend on trial results but this may be a promising option for rural communities.

- **Mast sharing.** The costs of providing a new mast ‘base station’ (macrocell) are high. A recent report for Ofcom estimated a new mast capital costs of £170,000 and annual operating costs of £16,000 (85). Whilst in areas of no mobile network


reception there will be no existing mobile phone masts to share it is possible that ‘similar’ structures may exist. Sharing an existing mast may significantly reduce capital and operational costs and make this a more attractive option that an entirely new mast. In many rural areas there will already be masts for the Airwave network, if an arrangement to share these were possible this would offer significantly improved network coverage for many areas (82, 83). Similarly a number of remote and rural communities have local airport facilities, particularly island centres. Many of these will have existing communication masts and if any potential to share these exists it may provide improved network coverage at reduced capital costs.

- Where it is not possible to share an existing mast it may be possible to provide a **new mast at an existing site**. This would provide a lesser reduction in capital and operational costs but still significantly less than the costs involved in providing a mast at an entirely new site. As above existing Airwave or local airport sites may be practical.

- Where sharing an existing mast or site is not possible then establishing a **new base station shared between providers** may be an option to spread capital costs. Each network is likely to use different equipment but around 2/3 of initial costs which relate to ‘civil works’ could be shared.

- As above costs for a **single operator new base station** site can average £170,000 capital and £16,000 recurrent. The disadvantage of bearing sole capital costs may in some part be offset by being the clear lead in network provision for the local population

- Multi-agency provision of rural base stations. Various models exist where additional funding has enabled provision of services, defraying costs where a purely commercially driven model has not provided these;

  - In the 1990s Vodafone and Cellnet (as O₂ was then known) worked with Highlands and Islands Enterprise and funding, largely from the European Union regional aid fund, to improve provision on arterial routes in the Highlands and islands (86, 87).

  - More recently in Mid-Wales a local community initiative with grant funding established masts which were then rented by network providers with the rental paying for mast maintenance (88).

  - Overseas examples include France, where co-funding by operators with local and national government meets costs of rural provision and Norway where state funding supports a revenue-based business case (70, 89, 90, 91). In Norway the goals include provision of coverage to all communities of more than 200 homes where these can be covered by a single mast.

c) **Major change options.** These would require changes in national mobile network policy. The NHS should be prepared to articulate a view with the aim of supporting improved provision with resultant patient care and organisational benefits.
- **Reduced tariffs** in rural areas with reduced service levels. At present subscribers in areas with reduced network provision pay the same charges as those in areas of full provision. This is particularly an issue for rural subscribers in areas with no 3G signal on hefty smartphone tariffs. It would be possible to stipulate that customers registered in a postcode where network provision is limited should pay a reduced tariff. This would incentivise networks to improve rural cover!

- **Limited personnel network roaming.** Currently within the UK there is a network roaming agreement for 999 emergency calls, a handset will default to an available network where the usual network is not available. Thus a user of ‘network A’ may find a 999 call made in an area with no ‘network A’ signal is routed via another network. It may be possible to extend this to specific groups of subscribers, say emergency service workers, rural GPs etc. such that all calls from can ‘roam’ and use any available signal if the ‘home’ network is absent.

- **General network roaming.** There is an argument that in areas where any customers ‘home’ network is absent then the handset should be able to use whatever network is present (as per the arrangement when overseas). Any such arrangement would require sufficient checks and balances by way of cross-charging to ensure that networks that have invested in rural infrastructure do not simply find these exploited by networks that have focussed more exclusively on urban provision. Lack of such cross-charging could even deter networks from developing rural services if it were perceived as simply providing rural infrastructure for other networks to use cheaply. There are already examples of emergency services using mobile phones on overseas contracts to enable network roaming in areas of poor reception (81). Interestingly ‘rural roaming’ was proposed by Vodafone and Cellnet (now O2) in 1985 (92). In France in conjunction with notspot recognition (above) local roaming was subsequently the preferred option in 70% of sites (90, 93). In Nordic countries national roaming is an established feature of service where a providers own network is absent locally (94, 95).

- **Satellite phone.** In Australia a ‘satellite phone subsidy scheme’ has existed since 2002 (96). In areas without mobile phone the cost of a satellite phone is subsidised. Whilst the distances involved in the UK are far less, provision of a subsidised satellite phone would provide a means of communication for emergency service workers in areas with significant ‘notspots’. At present rural NHS staff use a combination of pagers, mobiles on overseas tariffs, airwave radios and multiple mobile phones on different networks to provide some cover as they move between areas covered by different single networks. If network providers were required to subsidise satellite phones in areas of no coverage this would incentivise provision of rural reception.

- **National network with licensed service providers.** A similar model to the existing national rail network with multiple contracted providers. A nationally maintained network via which various service providers are licensed to provide services.

- **A national network and service provider.** It is difficult to envisage how a single provider model would work in a field of rapidly changing technology and ever changing consumer demands.
10. Mobiles and the quality agenda

Healthcare in the 21st century must embrace the quality agenda, it must be person-centred, clinically effective and safe for every person all the time (97). So how does this relate to the issue of mobile network provision in rural areas?

In 2001 the Institute of Medicine defined six dimensions of healthcare quality (97, 98);

- **Person-centred**: mobile use will allow greater delivery of service locally, improving the mobility of staff and resources and bringing care to the patient rather than patient to healthcare. Mobile technology has the potential to improve management of chronic conditions and individualise care (e.g. video consultations) (38 – 49). Supporting local provision of care in remote and rural areas has been a key theme of recent NHS Scotland publications;
  - *Delivering for remote & rural healthcare (2007)* (99)
    - “Access to healthcare should be as local as possible”
    - “The use of new technologies should be increased where this will maximise the amount of care that can be provided locally”
    - the future model should “shift the balance of care to locally based care”
  - *Better health better care (2007)* (100)
    - “delivering care as locally as possible” with “locally delivered services wherever possible, linked by new technology to specialist centres to provide additional support and information where this is required”.

- **Safe**: Mobile technology offers the use of computer based resources to increase patient safety (e.g. pharmacy related apps) and the potential to reduce unnecessary patient transfers by improving care of chronic conditions and enhanced (video?) consultations with staff at receiving centres (32, 38, 49)

- **Effective**: Smartphones offer the ready availability of current guidelines via apps (NICE, SIGN etc) and compliance with therapies have been improved using mobile phones. A reliable network would aid out-of-hours service provision (32, 80, 81)

- **Efficient**: In addition to the potential to improve patient care – better management of chronic conditions reducing hospitalisation etc., mobile phones offer the potential to access information / opinions far more readily. Improved triage of cases (the use of photos when referring burns, dermatology etc.) or video consultations avoiding unnecessary transfers. Further the current difficulties with communication in rural areas – multiple mobiles, pagers, non-UK contracts etc. all add to costs but for a patchy and often unreliable service. Comments from rural colleagues highlight the unreliability of mobile phones for use when on-call aggravating the difficulty of service provision in remote areas. The use of mobile phone technology offers a potential reduction in costs and greater efficiency both in patient care and directly related to communications

- **Equitable**: The use of a mobile phone is largely taken for granted in urban environments in Scotland. In rural areas GPs have an extended role incorporating aspects particularly of emergency care that urban GPs are not involved in (2). Often such rural areas have no mobile cover. Paradoxically the very areas which because of the distances involved would be most likely to benefit from mobile phone use do not have access to the service. This level of inequity deprives rural patients of the potential benefits and incurs additional costs to rural health boards. If the urban – rural digital divide is allowed to persist then this inequity will increase as technology develops (70).

- **Timely**: Clearly mobile telephony offers great advantages in terms of not only direct (speech) communication (e.g. for reaching the on-call Doctor etc) but also the potential to
send photos (does this patient with a burn need to be transferred?) or video consults. The ready availability of background information (apps etc) offer rapid access to supporting data and can improve decision-making. At 3 am on a rural trunk road coming across the scene of a road accident – a mobile phone with a network signal is far more timely than driving on in search of a phone box (24, 25).

Fundamentally a reliable mobile network would provide a service to remote and rural areas that would help with many aspects of healthcare provision. The provision of a reliable mobile phone network accords with the underpinning issues for healthcare quality. The NHS abhors inequity of provision, widening deprivation and wasted resources. By ignoring mobile network provision as an issue for direct NHS concern it allows the urban rural digital divide and the inevitable adverse impact on healthcare quality to persist.

11. Conclusions

Mobile phone technology offers an array of potential advantages to the NHS, many of which are particularly relevant in remote and rural areas. Unfortunately network coverage in these areas is often deficient. As a result the NHS in remote and rural areas is unable to offer these benefits to patients and the NHS incurs additional costs as a result.

In order to ensure that patients in remote and rural areas are able to share in the benefits that mobile phone use can bring to health care and in order to reduce costs incurred to the service, the NHS should actively seek improvements in mobile phone network provision in such areas.

Not only the various parts of the NHS, local patients and staff, territorial boards and the Scottish Ambulance Service, will benefit from improved connectivity. Mobile network coverage offers potential commercial, educational, tourism and service delivery benefits improving the sustainability of communities in remote and rural areas. The NHS must be prepared to work in conjunction with local government, transport and other community agencies to secure improved network coverage. A particular focus on improving network provision around transport hubs is essential.

In its 2009 report ‘Rural and Remote: Priorities and key issues’ the Joint Improvement Team (NHS Scotland, Scottish local authorities and Scottish Government) (101) recognised the need for;

- Evidencing the issue in relation to the IT infrastructure and its limitations on practice.
- Lobbying the case for enhancing the IT infrastructure.
- Influencing the centre to support joint working with other aspects of the public sector and others to explore possible funding solutions for enhancing the IT infrastructure.

NHS Scotland must recognise that mobile phone network deficiencies in remote and rural areas place restrictions on service delivery and incur the additional costs. Rural digital exclusion threatens to further disadvantage remote and rural areas and to marginalise communities. The NHS needs to be proactive in seeking to address this and should make improved rural network provision a key feature of eHealth developments.

Acknowledgements

Thanks to all those colleagues who replied to the mobile coverage survey.
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11. Conclusion

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## Appendix. Additional comments from NHS staff

Responses from staff in remote and rural areas to EMRS mobile phone survey, 2012 (not all those who responded left additional comments)

<table>
<thead>
<tr>
<th>Location</th>
<th>Comments</th>
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<tbody>
<tr>
<td><strong>Fort William</strong></td>
<td>• It really does depend where you are. I have areas of great 3G reception and then areas where there is no service – These vary. If there are major probs I have a hospital vodaphone mobile. In the hospital there is limited reception in theatres and in Endoscopy. -- the rest is OK but far from perfect.</td>
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<tr>
<td><strong>Oban</strong></td>
<td>• Vodafone coverage good @ hospital and patchy in area, reasonable 3G coverage @ hospital. O2 coverage 2G similar but 3G ?none @hospital / area</td>
</tr>
</tbody>
</table>
| **Orkney** | • There are areas within the hospital which can sometimes have very poor reception, notably when on the assessment and rehabilitation ward, but in general routine communication from switchboard is by mobile before pager is used.  
  • Vodafone and O2 give sensible 2G coverage across Orkney. Lack of 3G coverage (at least by Vodafone) is an issue. Open wi-fi internet (eg. BT Fon) at hospital could compensate lack of 3G to some extent, but there is no wi fi at Balfour.  
  • Vodaphone and O2 are not too bad but there are definite blackspots within the hospital. One such area is just around the resus area! I am not totally sure if it is a network thing or that my phones tend to be old or very cheap. I tend to have ones incapable of taking photos let alone being "smart" |
| **Shetland** | • Mobile phone coverage is patchy in Shetland. In the hospital coverage is good apart from in A and E when coverage can be very poor indeed. It is thought to be due to the proximity to X ray and lead in the walls?  
  • Reception in hospital generally good but does not reach theatre for example. Reception around Lerwick and beyond very variable, with a number of spots where there is no reception at all and others where reception is poor.  
  • Certainly less than 60% on Shetland with large swathes with no mobile comms. of any kind.  
  • Coverage with any of the networks in Shetland is patchy with around 40% of the islands not covered. Also appears to be very weather dependent – high atmospheric pressure = worse or no signal |
| **Stornoway** | • Generally my phone works well within the hospital premises however there is a loss of signal near the reception area and just outside until well into the car park. The outlying areas of the Western Isles often have poor or absent mobile phone signal which has major implications for emergency care in these areas. |
| **Wick** | • I do on call from home (or wherever I happen to be in NHS Highland) and my own network – TESCO Mobile — gets better coverage than Vodafone – in my house – in the town of Wick – I have to place my phone in set areas otherwise I get no coverage – not useful when on call – and I cannot wander when using it in the house or I lose signal.  
  • In the rural areas of Caithness – ie small villages such as Castletown, Lybster, Dunbeath and Watten – the mobile coverage is poor. |
### Community Hospitals

| 1 Arran | I also have an AIRWAVE handset issued via BASICS Scotland – and this improves coverage greatly, although there are still some patchy areas including most areas of my house. This provides much appreciated enhanced coverage, especially in terms of any lone working (e.g. home visits) required. Of course this is in addition to enhanced communications with our ambulance crew and EMDC. I use a SureSignal at home – issued by Vodafone which allows up to 4 mobiles to make calls at any one time, up to around 20 to be registered to it, and which uses my broadband connection to create a very local 3G cell … although my iPhone picks up the broadband wifi signal too so uses this in preference. The SureSignal – most of the time – offers greatly enhanced coverage. I would certainly support any moves to get Lamlash, and especially the hospital, covered better. It is a big issue that we have just got used to here, that a hybrid of mobile and pager networks are required to get the most effective coverage, and even then significant hotspots including centres of >1000 population such as Lamlash are without basic 2G phone/text coverage. This isn’t a good service from the mobile phone operators. One practical example of the problems faced: I use DropBox as a repository for EMRS SOPs that are handy for us to use. However, if these have not been recently downloaded to my phone whilst in an area of coverage, I have no access to these unless I use the internet from the hospital  
- Poor or no reception at base surgery, hospital or home. All in Lamlash. Haven’t bothered with 3G as reception so poor!  
- I have been on O2 and now Vodafone and mobile coverage including pager coverage is still a huge issue. very poor in Lamlash, nil for large parts of west of island, pockets of coverage in Lochranza and nil between Lochranza and Sannox,  
- The Arran GPs work from several widely separated premises. As it happens, mobile network coverage at Brodick Health centre is quite good – I have no complaint with the O2 coverage there. Unfortunately, Mobile network coverage at Arran War Memorial Hospital is (like most of Lamlash) non-existent. This renders most of my iPhone capacity entirely useless: no text to contact colleagues and patients; no internet access ‘on the move’; address book of limited value. Ironically this also adds to my Health Board’s costs: I have unlimited free calls on my iPhone, but use the BT landline network at AWMH as there is no alternative. Provision of WiFi broadband at AWMH has not been seriously considered due to conservatism in the A&A eHealth division. There are insufficient PC terminals at AWMH for all the staff who need to use them and they are poorly sited. Patients and their families also suffer huge difficulties communicating with relatives, taxis, ferry company etc, as though being held ‘incommunicado’ while trying to make complex travel and social arrangements. Many of them are also (informally) afforded use of the hospital landlines! |
| 2 Barra | Vodafone - no reception at all - only northern part of the island get calling signal, no 3G available anywhere. Orange calling signal only. No 3G available. Orange Service Coverage approx. 70% of the island, but large areas without coverage. All network coverage very poor and unreliable. Cannot rely on mobile coverage in case of emergency. No data service (eg 3G) available to use Medical Emergency Apps etc. Overall very poor performance. Intermittently also no network coverage at all due to maintenance issues, lasting for days at a time. |
| 3 Benbecula | - Because reception is patchy, I haven’t bothered with a 3g phone, my phone costs £10 and does calls and texts. In particular, reception is poor in both main places of work and at home, but is generally reasonable most other places I might be. I note that lots of medical apps are now available for i-phones; so far I have resisted getting one, because I think I would love it too much and end up with no friends.  
- The practice building and surrounding countryside is very good but the hospital building where our offices and A+E are located itself is zero. |
| 4 Broadford, Skye | - Orange mast behind the hospital in Broadford, so coverage good at the hospital and round abouts. Mallaig and Portree have Vodafone cover I believe. Re mobile internet (3G > E > o) I get consistent ‘o’ mobile internet, but it’s slow. Occasionally a 3G pops up in the good weather as Orange T-Mobile, presumably from a T-Mobile mast but I’m not sure where.  
- As a group we have paid for our own staff wireless BT hub so can use smart phone apps etc in Broadford hospital. I have no reception in my own home but my husband does with orange network ,we stay 5 miles from Broadford so is an issue with on call. We are supplied vodaphone network mobiles for home visits etc but there are large areas of Skye where there are no network coverage e.g. Tarsvakaig. O2 is probably the worst coverage on Skye with orange possibly the best. 3G services can be picked up in odd pockets like Kyle and at the Sligahan camp site!  
- Coverage in our area is dodgy. orange have a mast right next to the hospital so they have a good signal; but O2 and Vodafone use a mast above Kinloch lodge hotel and we are shadowed by hills; signal ok at front of hospital; not at back; weak in parts of Broadford and not at all in other parts. I live in Heaste 6 miles from Broadford; - no coverage at home; ok further up the hill. Driving to Portree coverage on and off with vodaphone and O2.  
- Orange mast behind Broadford Hospital so best for hospital use. Vodafone best for surrounding area but still major gaps in coverage. No 3G on Skye at all. In summary....mobile coverage in the Highlands Sucks - please fix :) |
<p>| 5 Bute | - I have had to buy a Vodafone Sure-signal box to get some coverage @ home where previously half of my house had no coverage. I still at best get a 2G signal. Vodafone map showed I should get some signal but because of the hills behind me it wasn't the case. It was a battle to get Vodafone to sell me a box @ a reduced price of £30 instead of £130 just because I was a customer for 25 years! We sometimes have to use a spare orange mobile phone as the vodafone signal goes down. During the storm in January I had no mobile for 2 weeks. |
| 6 Campbeltown |  |
| 7 Cumbrae | - Vodafone appears to be the network that works best on the island at present. All other networks appear to have very sketchy coverage and can be difficult to get a proper signal from them. |
| 8 Dunoon |  |</p>
<table>
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<td>Golspie</td>
<td>Vodafone is the best and probably the only choice. Mobile coverage is poor in the more remote areas we cover. You can not rely on mobile coverage in case of an emergency.</td>
</tr>
<tr>
<td>Islay</td>
<td>Vodafone is the best for Islay but can be variable and there are a lot of holes with no reception. Other networks are worse!</td>
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</tbody>
</table>
| Lochgilphead | O2 in Mid Argyll has pretty poor coverage. By far the most popular network with best reception (although still a tad patchy round here) is Vodaphone. I am only one I think who has persisted with O2 even though it’s useless in these parts!  
We have a reasonable (but sporadic) reception for O2 and Vodafone and for Three mobile broadband. It depends where you are in the building and some networks are better than others. Reception in the surrounding areas is very sporadic and non-existent in some areas of our patch e.g. Crinan, Cairnbaan, Achnamara. Good Vodafone coverage in Tayvallich but no O2 or Three coverage there. |
| Mull      | Am not sure about 3G as don’t use it but am told that it is not bad. Vodafone is pretty good in our area with just occasional black spots. Don’t usually have trouble unless weather bad and lines/masts affected. |
| Portree, Skye | I also work in Portree Hospital for occasional shifts and have no reception with 3 network and only patchy service in Portree town centre.  
I am on O2 and my partner is on Vodafone - in both cases coverage is patchy and inconsistent. It's not unusual to go several days without any service in an area which usually has service. And some significant settlements simply have no coverage at all. With modern technology (e.g. satellites and microwaves) there's really no need for any area to be without coverage if the some of the vast profits made by these companies were invested in better infra-structure for remote rural areas.  
Portree generally poor for all providers but Vodafone best for the area – rubbish in Portree Hospital itself though.  
The cover for the medical centre is patchy - in my room the mobile needs to be near the window to work. In the wider practice area there are parts with no mobile signal. This can be frustrating when you have to drive away until your mobile gets a signal. A few years ago they tried to bring in satellite phones but they also had patchy cover. In some places the TV satellite dishes for a house is on a tall pole yards away from the house to pick up a satellite signal. In windy weather the mobile signal can be lost due to the mast being affected. |
<p>| Stranraer | In Stranraer itself where hospital is, the coverage is good but further out into the GP practice areas the reception and mobile communication of internet etc can be poor |
| Thurso    |                                                                      |
| 1  | <strong>Acharacle</strong> | There are some areas which are very good – close to a mast, but more than a few hundred yards away, the reception goes to zero. The hilly area of this place compounds matters. Orange is probably the best with Vodafone second. The others are virtually non-existent. |
| 2  | <strong>Applecross</strong> | Mobile reception is extremely poor in my area with only a few reliable areas where it works, and this obviously has an impact upon both how I work, and my lifestyle! |
| 3  | <strong>Armada (Suth.)</strong> | |
| 4  | <strong>Aultbea &amp; Gairloch</strong> | Vodafone and O2 are the only networks with reasonable coverage. Reception is generally not bad but several areas and bits of road with no coverage. One of the worst is the Surgery itself in Aultbea. Mobile networks prone to weather disruption in winter. At best coverage is patchy and intermittent. Any network other than Vodafone is likely to provide little or no signal at all. The signal is non-existent on one side of our practice building, but only bad on the other. Reception at the other practice building in Gairloch is better. |
| 5  | <strong>Bunessan</strong> | The best network is predominantly O2, and secondarily vodafone. Reception is very sporadic, and nonexistent in may areas, including built up areas and parts of the road network. |
| 6  | <strong>Coll</strong> | |
| 7  | <strong>Colonsay</strong> | Overall mobile signal is poor on Colonsay and Oronsay (for all providers) despite a large central Vodafone mast. Reception is limited and is best in the inland western part of the island away from the public service areas. In particular there is no mobile phone signal at the surgery, at the hall and service point nor at the airfield where medivacs go from. The service is so poor we hardly use mobile phones and cannot rely on them. This can be particularly relevant if you are called out to a casualty where there is no signal or if waiting at the airstrip (in both cases it is likely the surgery will then be unattended) and there is then no direct communication with secondary care. We have tried sure-signal boosters at the surgery and doctors house but have not found them completely reliable. |
| 8  | <strong>Durness</strong> | Most of practice area has reasonable though patchy coverage on all networks. No 3G as far as I know. All networks available in most of the main village. East of Durness, Laid (West side of Loch Eriboll) has O2 only, East side of Loch Eriboll has no coverage. No coverage in Balnakiel (West side of village). |
| 9  | <strong>Eigg</strong> | |
| 10 | <strong>Glenelg</strong> | Although I have marked coverage as none, there is very limited coverage from Vodafone O2 and T mobile if you stand on the beach in the bay, or at the viewpoint at the mouth of Loch Hourn. There is no coverage elsewhere. 'Airwaves' coverage is better but still not complete. |
| 11 | <strong>Hillswick</strong> | |
| 12 | <strong>Hoy</strong> | There are many places where no coverage is available on the island of Hoy. This does mean that as you are traveling signal is often lost. Also there are areas of complete lack of reception most notably out at Rackwick and in Lyness Ferry Terminal. |</p>
<table>
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<tr>
<th>Jura</th>
<th>• Vodafone is probably the best network, although O2 also works (but not quite so well) on the Isle of Jura. However, reception on the island is extremely patchy and when a reasonable signal is found, it gets cut off frequently during most conversations. Sorry I don't know how good 3G service reception is here.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinloch Rannoch</td>
<td>• Recently we've had problems with Vodafone (just the last week) but normally have good coverage in the village of Kinloch Rannoch but variable coverage on the lochside. I had a lot of problems when in Rannoch station and on the north shore of loch Rannoch. Found it possible to send text to ambulance service but not call them. At that time they were able to text their base too but not call. I’m not sure whether this it is feasible to use VHF radio for communication between your helicopter and us when out on an incident in our area. What do you think?</td>
</tr>
<tr>
<td>Leverburgh</td>
<td>• Orange and Vodafone have better coverage than O2, and I think T mobile and Three are useless. Within our practice building there is only mobile phone reception at the windows – this is due to the type of insulation in the building, as there is excellent reception in the car park, but this is not really helpful when we have problems with landlines, and want to use mobile phones as a back up. We have explored having booster units in the building, but these were quite expensive, and we have not progressed this at present. We have quite significant problems with landline faults – over the past 6 months there have been at least 7 days when 999 calls were not possible in the village – our phone exchange is quite old, and relies on a microwave dish to pass on signals. It is almost impossible to get sensible fault resolution from BT – usually at least 3 hrs with a staff member on a mobile in the car park (usually in the rain!) We are just having an internet fault sorted – with no internet connection for 5 days over the recent bank holiday. Power cuts are also a major problem, with the electronic switch board meaning that calls to the surgery in a power cut cannot be taken. We are supposed to have a divert system in the electronic switch board, but it is not possible to test this until we have a power cut and the last time this happened, the system was not working…. Back to mobile phone coverage – essentially Vodafone and Orange work well if you have line of sight to the telephone masts to Mull. There is no coverage in the Loch Teagus area, and in the forests behind the hills. The main road from Lochaline to Strontian and Ardgour has good coverage – certainly for 2G cover – not sure about 3G as I do not use this. I will enclose a map of our practice area showing where cover is good or poor.</td>
</tr>
<tr>
<td>Lochaline</td>
<td>• There is good cover by Vodafone and various Vodafone dependent (Lebara, BT) providers within the village and along the lochside roads. There is no reception for 3 and some patchy O2 reception. I do not know about T-mobile or Orange. There are long stretches of road into and out of the village with poor or no coverage. Specifically Glen Mhor road (up to Rest and Be Thankful) has patchy cover, while Hell's Glen road (i.e. leading to the Dunoon road) has no cover whatsoever until one is beyond the last peak and has Inveraray in line of sight. There is only one mast supplying the area, this includes “Airwaves”, so when the mast is down – e.g last spring for 2 weeks following a lightning strike – there is no mobile connection whatsoever. The mast appears to get it own connection via landline, so cuts of the outgoing landline – which are frequent during storms or snow period will lead to total loss of outgoing communication and total loss of all mobile collection, though we retain often village internal landlines. This also affects Airwaves. There is a satellite telephone kept with the community police man. There is a small patch of road in Carrick (from just before castle onwards) where mobile reception from Long Long side masts can be obtained. We have used this to get a relay going – landline to house in Carrick, human messenger to road, mobile to ambulance control.</td>
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<td>Location</td>
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<tr>
<td><strong>Lochinver</strong></td>
<td>Very poor and unreliable coverage across a wide geographical area.</td>
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<tr>
<td><strong>Mallaig</strong></td>
<td>I am on-call 24/7 and rely on our Page One pager system (operated via the Balfour Hospital Switchboard in Kirkwall) to be contacted when away from the surgery – this appears to work in all areas of Rousay, Eglisay and Wyre (the 3 islands I cover) and the Orkney Mainland. Coverage is patchy using my network (Vodafone) but other networks do not appear to be significantly better. Our volunteer ambulance drivers have been provided with mobile phones from SAS with “roving” SIM cards using any available network but these too have proved to be unreliable with no mobile coverage at all available in some areas of the island. I was informed that NHS Orkney was planning to introduce satellite phones on Rousay on a trial basis but have heard no more about this. I understand that the Scottish Ambulance Service is looking into whether or not our ambulance volunteers would be able to make use of the Fire and Rescue Service’s pager system. Several smartphone apps do not work properly when there is no 3G or wi-fi access – the iResus app, for example, often tries to update when I attempt to open a guideline meaning that it cannot be relied upon in an emergency or even when training in the community (this app would have been particularly useful for ambulance volunteers). The GPS-based apps on my iPhone are more reliable, however. It would be useful to have some kind of app that clearly identifies my exact location and OS grid reference when calling ambulance control (there are no street names and only 3 or 4 postcodes on the island).</td>
</tr>
<tr>
<td><strong>Rousay</strong></td>
<td>I use vodafone, O2 and Orange are also available; I don't think there is much to choose between them at KLB end but vodafone significantly better at Scourie. Don't think any other networks available. I only use 2G services so don't know about 3G. KLB surgery - vodafone reception usually good. Scourie surgery - poor to non-existent. Home - worse than Scourie surgery. Kinlochbervie village has very poor or non-existent airwave coverage</td>
</tr>
<tr>
<td><strong>Sanday</strong></td>
<td>Each year we have outages of mobile cover for a few days usually related to severe weather. In addition inside most of the older traditional stone built buildings [ such as the surgery ] there is no mobile coverage .</td>
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<td>Location</td>
<td>Details</td>
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<tr>
<td><strong>Stronsay</strong></td>
<td>Very patchy reception. The pager system is moderately reliable but mobile phone reception has many black areas which confusingly vary dependant on mystery factors. The buildings are mostly of traditional stone design and this reduces reception very significantly. I recently tried a mobile / satellite phone from NHS Orkney. This device choose the best signal for regular mobile phone coverage which was usually O2 (set to be first choice by manufacturer) or Vodaphone, but other networks occasionally were chosen. Outside I did not find an area of no constant reception so the device never looked for a satellite signal. However sometimes the mobile reception has very poor and difficult to communicate. Some patients do not have a land line even though they know how poor the mobile phone reception is.</td>
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<td></td>
<td>- NHS Orkney use Vodafone for staff mobiles, but, for example, where the on call nurses stay there is no land line, and only one corner of an upstairs room, with the phone held up towards the ceiling, provides connection with any mobile service, and that is intermittent at best. Often we end up having to drive to their house en route to a call out, to alert them. O2, from visitors, seems just as bad, as is Orange, and the others just don’t connect at all anywhere on the island. Spots that sometimes work often don’t. And although it is possible to receive or send texts from a few places on the island, most of the time they seem to be lost in time and space, often arriving many hours after being originally sent, even if reception as stated on the phone, was 2 bars. 2 bars of signal is often as good as it gets when we do have a signal. We have no emergency service on the island here except us and the nurse, and one volunteer ambulance driver, so communication is a vital part of our work. Sadly, the lack of it means that there are inevitable delays when out and about at incidents. The ability to be in direct phone contact with EMRS whilst beside the patient would be highly desirable, but it is not possible at all just now. It really would transform our working lives and patient safety here.</td>
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<tr>
<td><strong>Tarbert, Harris</strong></td>
<td>Vodafone is still meant to be the provider with the widest coverage locally but there are lots of black spots and many areas of the practice which have no coverage. At home (from where I do most of my On call) I use Vodafone Suresignal – which transfers the mobile phone signal via my wireless broadband.</td>
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<tr>
<td><strong>Tiree</strong></td>
<td>Vodafone and O2 have similar coverage. Many parts of practice catchment area have no coverage at all. There are no areas where you can use a hands-free system. If you want to use a mobile you have to remain stationary in an area where you can get a signal.</td>
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<tr>
<td><strong>Torridon</strong></td>
<td>Reception in Torridon and Kinlochewe but about half the area has no signal at all. The other factor I would like highlighted is that the village I stay in has no mobile coverage and I am on call from home for OOH and BASICS calls. I live in Kishorn, Ross-shire, IV54 8XB. There are also two other local GPs and a midwife staying in the village. The most frustrating aspect is that there are mobile masts in the middle of nowhere about 2 miles from the village that appear to serve no-one.</td>
</tr>
<tr>
<td><strong>Ullapool</strong></td>
<td>We all use O2 and have iPhones in Ullapool. The majority of our patients live within 2G range. The cases which cause us most difficulty for mobile coverage are MVAs or when we are involved in mountain rescue incidents. We have large areas of hill with no coverage at all but very few patients in these areas</td>
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<td><strong>29 Unst</strong></td>
<td>• In Baltasound and the areas of Unst further north there is only Orange reception. It is very good when it is working, but relatively often we have periods of several days when there is no signal. I do not try to use mobile internet so I am not sure what the answer is to this question. In the south of Unst (Uyeasound and Westing) there is only Vodafone reception. My impression is that this does not disappear as often as the Orange signal does, but I rely on it much less so it is hard to say. In summary: we each carry two mobile phones so that we are contactable all over Unst, but there are long periods when there is no Orange reception and we rely on leaving messages about where we are going and on use of landlines.</td>
</tr>
<tr>
<td><strong>30 Walls</strong></td>
<td>• Best local network is Vodafone which is not saying much! Staff and I between us estimate that coverage within the practice area is probably less than 10% of inhabited locations, worth noting that broadband access also poor or slow via phone lines. No 3G coverage at all in our practice area, in Shetland as a whole only accessible patchily within the main town of Lerwick. Some of the other networks listed have either no coverage here or even worse than Vodafone • Not actually tried a 3G device personally. Generally mobile reception is very patchy with small 'islands' of reception perhaps only 50 m across separated by longer distances without signal. I admit was not aware of the trial you mention and do not routinely use mobile phone in the practice area because of the poor reception although do carry it on the off chance in case of emergency.</td>
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<tr>
<td><strong>31 Westray</strong></td>
<td>• Broadband internet access is intermittent/poor in Westray and there is no mobile internet. In the majority of Westray there is only a service from Vodafone and O2, there is a very small area in the south of the island which receives other services but few houses are in this small area. No locals use other services. Tourists arrive and immediately lose all phone services if they do not subscribe to Vodafone or O2. Our mobile services can be affected by poor weather, transmitters are affected by storms and it then takes time (days!) for mobile services to be restored.</td>
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<tr>
<td><strong>32 Whalsay</strong></td>
<td>• A lot of Whalsay seems to have no Vodafone connectivity so I rarely use my mobile for clinical emergencies involving patients. Instead I use landlines, a bleep, motor car to get between sites, messages via intermediaries, etc.</td>
</tr>
<tr>
<td><strong>33 Yell</strong></td>
<td>• Patchy signal, covers about 70% of the island. However where it would be essential (ie on roads where RTAs will take place and no land lines) reception is very poor.</td>
</tr>
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Nurse practitioners

<table>
<thead>
<tr>
<th>Island</th>
<th>Notes</th>
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<tbody>
<tr>
<td>1 Eday</td>
<td>Many houses and rural areas on the island, including the tourist accommodation and the big bird observatory, have no mobile signal, or very poor signal. I have tried a pager but there is no coverage. This means that the nurse often cannot be contacted. In addition the internet speed is very slow indeed. Evacuating patients from Fair Isle is complicated in any case; having no mobile communication can make things even more difficult.</td>
</tr>
<tr>
<td>2 Fair Isle</td>
<td>Most of Flotta has good coverage but we have several known areas on island with no mobile cover at all and limited pager cover.</td>
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<td>3 Fetlar</td>
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<td>4 Flotta</td>
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<td>5 Foula</td>
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<td>6 Gigha</td>
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<td>7 Kilchoan</td>
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<td>8 Lismore</td>
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<td>9 North Ronaldsay</td>
<td>There are areas at the south end where coverage is poor/absent, despite a node point on a tall mast at the north end. Reception over water from neighbouring Sanday can be patchy. Orange reception is non-existent in island, Vodafone and 02 ok subject to above, not sure about others. Had Orange before, very patchy anywhere in Orkney and very poor in North Ronaldsay. O2 Slightly better in North Ronaldsay, but still very patchy. Difficult at times to contact Nurse Practitioner in North Ronaldsay when she is out due to poor reception (she uses Vodafone which is better around the surgery) Very difficult at times to get a signal the worst network is orange. We also have very slow internet access.</td>
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<td>10 Out Skerries</td>
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<tr>
<td>11 Papa Westray</td>
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<tr>
<td>12 Raasay</td>
<td>Some parts of the Island have no mobile phone signal over a range of approximately 5 miles. We are however, working alongside SAS to provide 999 cover and they have given us a GPS closed band air wave radio which does work in those remote locations.</td>
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