Telemedicine support to home renal dialysis patients– An Adoption Study

Identifying and communicating benefits to aid adoption of telemedicine and support business case development: Lancashire Teaching Hospitals NHS Foundation Trust

Final Research Report – May 2015

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Executive Summary

Introduction

- Video-as-a-service has been successfully used for nurses to remotely support home dialysis renal patients in Cumbria and Lancashire. Progressing from a successful pilot to mainstream adoption requires engagement with managers and commissioners to understand the contractual and organisational implications and present a business case. In order to do that, evidence from user stakeholders (staff and patients) was collated and presented in a way that can be used to support decision making.
- The Cumbrian Centre for Health Technologies (CaCHeT) at the University of Cumbria was engaged to undertake an Adoption Study using their Stakeholder Empowered Adoption Model, an approach that involves engagement with all key stakeholders to understand barriers to and enablers of adoption.
- Our objectives were to understand, from the viewpoint of stakeholders, what are the barriers to and benefits from using the renal telemedicine service and then to identify these barriers and benefits to managers and commissioners with the aim of aiding adoption of the technology

Methods

Qualitative interviews with staff and one patient were undertaken, as a service evaluation. Data sources were also reviewed and where possible records were studied. Working closely with the Renal IT Manager, methods to improve information management and cost modelling were developed.

The interviews and discussions were transcribed and analysed to identify key themes. These are summarised below, with relevant quotations from staff and the patient who took part. Where appropriate, recommendations are given to suggest how this qualitative benefit could be quantified to support a business case for telemedicine.

Qualitative research findings

Benefits of the telemedicine service

Staff and patients perceived a number of benefits, to patients, to staff and to the service.

The specific benefits to patients of using telemedicine are:

- Increased confidence through continuing support, leading to improved ability to self-manage;
- More likely to continue with home dialysis as support is more available;
- Improved patient experience, quality of life;
- Patient empowerment.

The benefits to the Renal Service of using telemedicine are:

- Lower costs of supporting a patient at home, especially in rural areas where patients are dispersed;
- Reducing pressure on the very specialist renal nurses, who are hard to recruit, retain and required to work under considerable pressure to meet the needs of all the home dialysis patients.

The most significant benefit is therefore the ability of telemedicine to enable more efficient use of nursing staff time.

Other benefits include:

- Avoidance of unnecessary maintenance visits;
- Reduction in emergency and unplanned hospital attendances.

Staff benefit from using telemedicine too. It was reported that the telemedicine plays an important role in alleviating worry for the nursing team and hence to a better job satisfaction, improved morale and quality of working life.

Concerns and issues to be resolved

As part of our discussions we asked staff to reflect on their initial reservations with the proposed telemedicine implementation, all of which were addressed and overcome once the telemedicine was introduced. The initial reservations related to job concerns, possible increases in job complexity, concerns that it was driven by commercial supplier motivations and the investment implications.

Some ongoing issues remain and are being addressed, where possible. Patients and nurses reported concerns with access due to the limited number of video lines into the service and the fact that currently only one video communication can be live at any time. There were operational difficulties with delays in installation, which need to be ironed out.

Several technological changes can easily be and probably will be implemented, learning from experience and taking advantage of new products now available. These include using the patient's own broadband connection or even a lower cost VirginMedia connection service, using standard resolution video (could be patient owned iPad or smartphone) for patients once they are competent and confident and implementing a call waiting facility.

Patient selection

Staff noted that there are stringent criteria for patients to be suitable for home dialysis. Some patients do not have space at home, do not have adequate carer support, or simply prefer not to take responsibility for something difficult and potentially risky. There is, however, great interest and desire to have home dialysis with telemedicine support.

Extension of telemedicine to other services

Some obvious opportunities exist to extend the use of the video links across the renal service and potentially to other services. Those noted by staff include:

- Extension to peritoneal dialysis patients (high definition cameras not necessarily required);
- Use within the clinical team for meetings and consultations (already happening);
- Using for consultant led clinics, when a physical examination is not done;
- Use by technicians and multidisciplinary teams.

New features

The new machines being installed have a telemetry function that can be used to acquire information directly, rather than relying on patients recording it. If this could be fully utilised, significant improvements in understanding patient symptoms could follow, with the possibility of changing dialysis parameters between check-ups. The possibility of recording telemedicine consultations (for training and liability protection) with nurses has also been raised, although this would have ethical, privacy and possibly security issues to be addressed.

Related work elsewhere

A literature search was performed on academic databases. The work identified included the use of telemedicine for peritoneal dialysis in the home, but not for home haemodialysis. Reports were also

given of use of telemedicine between regional centres and satellite units. We conclude therefore that the work at Lancashire Teaching Hospitals is novel and world-leading.

Cost model

This consultancy exercise did not cover detailed cost and benefit analysis, due to limited time. Much of the information needs to come from the renal service and, due to pressures of work, it was not possible to obtain these within the timescales. However, our conclusion is that a) there are opportunities to reduce the per-patient annual cost, as the current service is over-specified and b) economies of scale have not yet been realised with only 4 units available.

Further investment is likely to be required and there are ongoing running costs for the hosting and maintenance, but costs savings can be identified through economies of scale by judiciously extending the service. It is possible that some contribution to the investment could be secured from one of the relevant charities (British Kidney Patient Association, the National Kidney Federation etc.).

Conclusion and recommendations

There is very strong qualitative evidence that telemedicine is making a strong impact on patient experience, empowerment and staff efficiency. Quantitative evidence is hard to uncover and needs some dedicated work to bring this out, but anecdotally there are significant time savings for critical front line staff. The emerging evidence is that telemedicine has the potential to enable more renal patients to be offered home haemodialysis, in line with clinical best practice and NICE guidelines.

Major investments have already been made, through grant funding and use of internal Trust monies. This has proved the concept, but the indication is that some increase in scale is necessary. A business case needs to be made to support this. Our recommendations for the business case development are:

- Identify cost of an emergency unplanned admission. Review how many happen per year and how many could be prevented if telemedicine were available.
- Review patients who have had to discontinue home dialysis and identify any that could be prevented if telemedicine were available.
- Complete the information on the 6 case histories so that comparisons can be made of the care provided to patients receiving telemedicine and those not receiving it.
- Start to record video calls by maintenance team and any benefits. Analyse site visit records and review which could have been avoided using telemedicine.
- Create a model that can be extrapolated if more patients are included.
- We also strongly recommend that the Service moves as quickly as possible to using integrated digital patient records, that can be updated from any device at any location by any staff member. This would not only help in business case development for this and other service improvements, but it would reduce staff workload. We realise this is a difficult task to implement within the NHS, but would note that current practices may place patients and the Trust at risk if patient safety is compromised by critical information not being available when needed.

Lancashire Teaching Hospitals Trust is already exceeding national averages for numbers of patients receiving home dialysis and is actively looking for ways to use technology to increase these numbers further. Staff and partners should continue to promote and disseminate this activity, both internally and externally. Finally, if it is thought to be useful to the development of the service, a larger and more in depth research study on patient attitudes and benefits could be commissioned.

1 Introduction

The regional Renal Centre at Lancashire Teaching Hospitals provides treatment and care for patients suffering from kidney problems across Lancashire and South Cumbria. Dialysis patients usually have to travel to hospital up to three times a week where each dialysis session can last up to four hours at a time. Taking into consideration journey times required for travel to and from the hospital, attending renal appointments in hospital is time-consuming. For some patients due to geographical location, it can take a whole day. Home dialysis can be an attractive alternative for some patients, if they have the resources and capabilities required. Home dialysis is not new, and has been made available to patients since the 1960s, but requires considerable investment by the NHS and commitment from the patient and carer(s)

The National Institute for Health and Care Excellence (NICE) has recommended that all patients who are suitable for home haemodialysis should be offered this option. In general, patients who are suitable for home dialysis are those who:

- are able and willing to learn to carry out the procedure and to continue with the treatment;
- have remained in a stable condition while on dialysis;
- do not have particular problems associated with their kidney disease or other diseases that would make it too difficult or unsafe to carry out haemodialysis at home;
- have blood vessels that are suitable for inserting the catheters (tubes) that carry the blood to and from the dialysis machine;
- if necessary, have a carer (or more than one carer) who has decided, after discussing all the issues, to help with the haemodialysis;
- have a home that already has enough space and facilities to set up and use the kidney machine, or whose home could be adapted to provide the space and facilities needed.

Clinical Practice Guidelines of the UK Renal Association (RA) recommends that all patients who may be suitable for home dialysis should receive full information and education about home haemodialysis. It is suggested that some patients may need to travel to a sub-regional or regional centre to pursue their choice to train for home haemodialysis as haemodialysis training is not available in all renal units. Self-treatment at home is also recommended as the best way to perform daily short or daily nocturnal haemodialysis.

Training in Lancashire and South Cumbria is provided from Chorley Home Training Centre. For dialysis monitoring and support, the home therapy services is available from three sites – Preston (hub), Barrow and Chorley, with satellite dialysis units at Blackburn, Accrington, Burnley, Kendal and Clifton. There is a peritoneal dialysis (PD) unit at Barrow. A team of community renal nurses provide support to home haemodialysis and home peritoneal dialysis (the latter is more common and less risky). Haemodialysis Training in dialysis normally takes 6-8 weeks, with patients training 5 days per week. Working with nurses at the renal unit, patients learn how to prepare equipment and dialysis machine supplies, place the needle in the vascular access, commence and discontinue dialysis, monitor the dialysis machine therapy and check and understand their vital readings blood pressure and pulse. They are also taught to keep records of the treatments and keep track of supplies so that they can be re-ordered. Patients are shown how to clean the equipment and the room where they perform dialysis. Patients then return to hospital every three months to see their renal consultant, nurse or dietician. Patients are also taught how to deal with complications that can occur on dialysis potential problems, including haemorrhage.

After training, a home dialysis patient would normally be supported at home by a nurse. For the first few weeks, the nurse would stay with the patient through the dialysis period of 4-6 hours. As the

patient gains confidence and capability, the nurse does not need to be with the patient for so long, but may come at the start and the end of dialysis. However, since patients (particularly in South Cumbria and rural Lancashire) may be geographically dispersed, this option may not be viable, meaning that effectively the highly skilled and specialised nurse time is not well used. Once the patient is confident to self-manage, the frequency of nurse visits is reduced. Patients have access to the service by a dedicated 24hour phone line and attend hospital for consultations approximately every 1 to 3 months .

The renal telemedicine service started in Lancashire in 2013. There are four renal telemedicine units in use, which are transferred between patients as they come on or off dialysis (dialysis is generally terminated either by transplant or death, so average periods on dialysis are around 18 months). However, many patients are on home haemodialysis for many years (many over 10 years). At present, seven patients have used the service. The haemodialysis machines at the patients' homes are linked and interfaced with the main renal unit IT systems at Preston). This allows the specialist renal care team to remotely access and subsequently monitor vital data from the haemodialysis machine at the patient's home. The system uses a rotating PTZ (pan, tilt, zoom) high definition video camera installed at the patient's home. The patient initiates a video call, but the nurse can take control of the camera and zoom in, for example, to examine a fistula, assist needle insertion or to examine the controls of the machine. The connection and online service is provided by VirginMedia, with technical support by Imerja Ltd.

Home dialysis is a NICE guidance objective. In the UK, the overall percentage of dialysis patients receiving home haemodialysis has increased from 3.4% in 2011 to 4.1% in 2013. The Royal Preston Hospital Renal Service currently provides home haeomodialysis to approximately 40-45 patients, representing 7% (619 haemodialysis patients).

2 Aims and Objectives

The Renal Telemedicine Service has operated from external and internal project grants, to support investment in equipment, with ongoing costs sought from the departmental budget on a year by year basis. This (coupled with other austerity issues for the Trust) has led to uncertainty and limited the ability of the service to be able to think strategically about longer term use. The aim of this study was to provide an independent analysis of the benefits and challenges and to plan an approach to measuring success.

The objectives of the study were to:

- understand the different stakeholder perspectives of managers and commissioners
- evaluate the benefits to the staff and patient stakeholders
- understand barriers to adoption of renal telemedicine
- propose a model for the Renal Service to assess and measure the value of using telemedicine for home dialysis.

3 Design and Methods

The parameters of the service were established by a number of in depth meetings with the Renal IT Manager at Lancashire Teaching Hospitals (Scott Rayner). Individual and group semi-structured interviews were held with:

- Renal Business Manager
- 2 x Renal Consultants
- Renal Matron
- A member of the Renal Technical Team

- 3 x Renal Nurses

One renal patient, using the telemedicine equipment, was visited and interviewed in his home. The participant information sheets and interview questions are included in appendix.

With the IT Manager, a review of information systems was undertaken. Detailed case histories were developed for 3 telemedicine patients and 3 home dialysis patients with similar profiles, with a view to assessing the difference in nursing support and hence costs.

A general discussion of costs was held, with the Renal Matron, the Technical Manager and the Business Manager.

Finally, a brief literature review was undertaken to confirm that the Royal Preston Renal Telemedicine Service is innovative on a global scale.

4 Qualitative Research Findings

The interviews and discussions were transcribed and analysed to identify key themes. These are summarised below, with relevant quotations from staff and the patient who took part. Where appropriate, recommendations are given to suggest how this qualitative benefit could be quantified to support a business case for telemedicine.

4.1. Benefits to patients of using telemedicine

It is well established and documented that patients benefit significantly from home dialysis, as it removes the (often considerable) travelling time requirements. In analysing the reason, we focused on the benefits that telemedicine brings over and above the benefits of home dialysis that they would experience anyway, but it was understandably difficult to separate the two threads. In this analysis, we take as a baseline that home dialysis is clinically and socially desirable and that it (therefore) leads to better clinical outcomes.

The specific benefits to patients of using telemedicine are:

- Increased confidence through continuing support, leading to improved ability to self-manage;
- More likely to continue with home dialysis as support is more available;
- Improved patient experience, quality of life;
- Patient empowerment.

4.1.1 Increased confidence

The patient and several of the staff interviewed described the increased confidence on both sides as a result of having direct, real time, visual contact whenever the patient is dialysing and needs help. Not only does this provide a vital safety net, but it also gradually improves and enhances their level of skill.

"if a nurse can't be there for every home visit, they know that they've got a means of repeat contact," (renal nurse).

"*They can see the needle, really just zoom in,*" (patient).

"you've got the back-up there and you're not on your own, really because you can call them if you want to," (patient).

"When patients first go home, we do like a step-down process from what we do in the room here. The system allows us to do that quicker," (renal nurse).

"I can see it instantly what the problem was just by beaming in the machine," (renal nurse).

However, more significantly, the renal team can intervene much more quickly if problems occur. With the conventional support, a nurse may have to advise the patient to terminate dialysis. Not uncommonly, simple problems that could have been quickly solved in a clinical environment can quickly escalate to an emergency and an ambulance call need to be made.

"I've witnessed two events where one where the needle popped out and blood gushing everywhere and the nurse, I was stood behind the nurse in Chorley – normally what she would do if the patient could get to the phone, they could ring 999, or they'd call the nurse up, the nurse would call 999, no messing about, ambulance straight round and the patient would come into hospital, but she calmed the patient down, managed to clamp his line off, disconnect him, take everything out stop the machine and dealt with it all on telehealth" (renal technical services manager).

"…for instance a patient rang up yesterday, had a problem with a machine and I was trying, "right what's illuminating, tell me again" …and then in the end I had to discontinue the dialysis because I couldn't be certain in my mind that it was set correctly… Whereas if I had been able to see straightaway what the problem was I could have solved it. When it's on the phone with the patient and the relative was panicking, the, trying the best to explain what's happening you sometimes you have to do things quite quickly to resolve the problem and you can't push them too quickly to solve because they've got to logic that first step that you've told the m and in the end I just thought I'm going to have to say no, come off.." (renal nurse).

"I couldn't see whereas if I had been able to see straightaway what the problem was I could have solved it," (renal nurse).

"you've only got twenty minutes to get that sorted because then the circuit clocks off and that's when they become stressed,"(renal nurse).

"so it's that you have to get past what machine they're on, then you've got to remember what to do next but if you can see straightaway you can visualise it, it's just so much quicker," (renal nurse).

"One patient lost 4 sets of dialysis lines which is equivalent to 4 units of blood, if he'd been on telehealth, I could instantly solve the problem because it was one little clamp, and that is all it was," (renal nurse).

This could be very significant. The cost of an emergency is high and a poor use of hospital facilities if it is preventable, with pricing from tariffs perhaps making it even more undesirable. The impact on the patient is high and may even be fatal.

Recommendation for business case development

Identify cost of an emergency unplanned admission. Review how many happen per year and how many could be prevented if telemedicine were available.

4.1.2. More likely to continue

A number of the challenges that cause patients to discontinue home dialysis can be overcome using telemedicine.

"That could stop them from coming in, have they got a cloudy bag, yes show me," (renal nurse).

"the likelihood of them staying home is higher because they've got much better support than normally," (IT team member).

Recommendation for business case development

Review patients who have had to discontinue home dialysis and identify any that could be prevented if telemedicine were available.

4.1.3. Improved patient experience

Home dialysis improves quality of life, whether using telemedicine or not (*"They can plan dialysis around their life. If they need to have hospital dialysis, they have to plan their life around the dialysis"* (Renal consultant)).

We identified evidence also of increased benefits from having the reassurance that help is always on hand. This is a subtle point, that links to other benefits, rather than being a tangible and easily measurable impact.

"If I hadn't got telehealth, my wife would probably have had to give up work to be here three days or four days a week," (patient).

"The patient is calmer and not as nervous as before" (IT staff).

"Telemedicine increases confidence – the patient could do more." (Renal consultant).

"*this gives you that safety blanket because I think the first three months to get the confidence and then they'll say well I don't really need that anymore and you see that very much with the telehealth,"* (renal nurse).

"*With the telemed it's quick, you can speak to somebody,"* (patient).

"I've spoken to them [nurses] about lots of things," (patient)

4.1.4. Patient empowerment

Ultimately, telemedicine supported home dialysis is thought to be an optimal way to empower the patient so they are more effective at self-management, leading directly to improved clinical outcomes. The patient (or carer) acquires the complex technical skills more quickly and may then be able to adapt the programme to suit their particular circumstances.

"the idea is for them to do it themselves," (renal nurse).

"he did what I told him and got back on dialysis within 5 minutes," (renal nurse).

"Certainly the first month they might ring every session and after that it starts tailing off," (renal nurse).

"*if there's any problem, I can just dial from home, get some advice form the nurse or they'll get the doctor, technician or whatever,*" (patient).

"*Finish dialysis on Friday, wife comes home from work and we go off, have a weekend holiday and back on Monday to dialyse*," (patient).

"Telemedicine increases confidence – the patient could do more. Many patients choose to dialyse 4 – 5 days per week, which is better. In hospital they can only come 3 times a week," (Renal consultant)

Recommendation for business case development

If it is thought to be useful to the development of the service, a larger and more in depth research study on the patient attitudes could be commissioned.

4.2. Benefits to the Renal Service of using telemedicine

Supporting a patient at home, especially in rural areas where patients are dispersed, is expensive. The very specialist renal nurses are also hard to recruit, retain and required to work under considerable pressure to meet the needs of all the home dialysis patients.

The most significant benefit is therefore the ability of telemedicine to enable more efficient use of nursing staff time.

Other benefits include:

- Avoidance of unnecessary maintenance visits;
- Reduction in emergency and unplanned hospital attendances.

4.2.1. More efficient use of nursing staff time

Nurses can provide support from base, rather than in the home. As they are at base, they can do other tasks while keeping an eye on the patient. The visual contact means that issues can be dealt with very much more quickly. This enables them to provide support over a longer period – an hour or two a day, rather than a full dialysis session once a week.

"… when patients first go home, we do like a step-down process from what we do in the room here...a nurse who goes every day, .. in a visit for 4 hours if not more sometimes just 6 hours. They're on the machine, they're sat and they don't leave them. And that can happen for two weeks - a lot of wasted time, from a point of view as a manager" (renal nurse).

"Previously a nurse would be with the patient full time for their first two weeks of home dialysis. Now it may only be one day" (renal matron).

"it's like a few minutes on the job so what in fact would normally take you twenty minutes to half an hour on the phone," (renal nurse).

This represents a significant cost saving, but more importantly these nurses are very highly specialised, experienced and know the patients, so this is a scarce and critical resource that needs to be well managed. It became clear that the pressures on the nurses are creating stresses to the individuals that is having an impact on the service as a whole.

The critical piece of data we sought to identify was the difference in nurse time spent with patients with and without telemedicine. Data is not recorded centrally, as the individual nurses have their own records which are only periodically updated when they have time at base. Separate paper based records are kept at the main Hospital, at the training centre in Chorley and at the satellite centres. The digital hospital record is a summary only. Consultant notes are kept separate from nurse notes. An approach was developed in which 3 patients receiving telemedicine and 3 patients not receiving telemedicine, but thought to be comparable, were selected. An outline of a full patient record was developed and this is now available for staff to update from their own records.

Recommendation for business case development
Complete the information on the 6 case histories so that comparisons can be made of the care provided to patients receiving telemedicine and those not receiving it.

General recommendation
We strongly recommend that the Service moves as quickly as possible to using integrated digital patient records, that can be updated from any device at any location by any staff member. This would not only help in business case development for this and other service improvements, but it would reduce staff workload. We realise this is a difficult task to implement within the NHS, but would note that current practices may place patients and the Trust at risk if patient safety is compromised by critical information not being available when needed.

4.2.2. Avoidance of unnecessary maintenance visits
The maintenance team install, commission and provide support to home dialysis equipment. There have been cases where they are able to avoid a site visit by using the video link. It was noted that high definition cameras are not necessary for this aspect of the service.

"*We can solve problems more quickly and sometimes without a visit as they can see the machine, the error messages. The patient can point to a component that they may not know the name of." (renal maintenance team).*

The maintenance team do not keep records of phone calls or video calls to patients, but do keep records of site visits.

Recommendation for business case development
Start to record video calls and any benefits. Analyse site visit records and review which could have been avoided using telemedicine.

4.2.3. Reduction in emergency and unplanned hospital attendances
This benefit is discussed above in section 4.1.1. as it is also a patient benefit. However, note the recommendation there in the context of service benefits too.

4.3. Benefits to staff of using telemedicine
The nursing staff are clearly operating under pressure, with some on sickness absence. It was noted that concerns around the team's ability to deliver caused stress and the strong professional care ethic caused concern when patients were clearly not able to cope on their own. It was reported that the telemedicine plays an important role in alleviating worry for the nursing team and hence to a better job satisfaction, improved morale and quality of working life.

"*we feel more at ease with sending patients home knowing that we've got that [referring to telemed],"* (renal nurse).

Nurses are also able to train patients more successfully and to feel confident in the transfer from training to home.

"A lot of the time, if you're in the room the whole time with the patient and you're at the side of them, as good as your are, you're so eager just to help them stop, and that's not the idea, the idea is for them to do it themselves," (renal nurse).

"*Whereas with this, we can step away, ok line's gone off right, let's see if this will solve it,"* (renal nurse).

The interviews were held in the training suite, while a patient was being monitored in the background, on screen.

"can you imagine that [referring to the telemed system] not being there, I'm having this meeting and I can't see them," (renal nurse).

"Before, with a new patient, I didn't feel comfortable coming in here [referring to nurses' room] whereas now I can keep my eye on her and do some work on the computer, finish my emails off, desk work," (renal nurse)

5. Adoption of renal telemedicine

5.1. Staff motivation to take part

As part of our discussions we asked staff to reflect on their initial reservations with the proposed telemedicine implementation, all of which were addressed and overcome once the telemedicine was introduced. These are noted here for information and consideration if new staff need to be introduced or if telemedicine is rolled out to other services.

The initial reservations related to job concerns, possible increases in job complexity, concerns that it was driven by commercial supplier motivations and the investment implications.

"I think it replaces that nursing home visit, that's actually hands on nursing and that's what my worry was. It was a way of cutting back on staff as well, if you will" (IT personnel).

"*You've got to learn 6 different machines and something else comes in that's new and we're like oh no!"* (renal nurse).

"*I was sceptical. VirginMedia were involved – were they trying to make money?"* (business manager).

"*I was not all that excited. The first suggestion came from IT and a company presentation that was not very impressive. Their presentation was more about experience with respiratory medicine and renal is very different"* (renal consultant).

"Initial costs were of the order of £20-30k for equipment" (renal consultant).
The staff and suppliers proposing the telemedicine were able to make a strong case and influence both the clinical and business staff, in part because external income had been secured. Lessons learned from this are that any possible concerns should be addressed in any pilot. There is also growing evidence that introduction of telehealth and telemedicine should be done in tandem with appropriate training and development support for staff. However, in this case, it is clear that the whole team are now convinced of the value of telemedicine.

5.2 Issues and problems with current service

In this section we note a number of issues and problems with the current service. Patients and nurses reported concerns with access due to the limited number of video lines into the service and the fact that currently only one video communication can be live at any time. There were also operational difficulties with delays in installation, which need to be ironed out.

"*The only thing I don't like is the fact that a patient had to ring me on the landline to tell me to switch this one off because you can only see one at a time,"* (renal nurse).

"the biggest problem we've had with it has been getting the call waiting," (renal nurse).

"we can have people doing their routine jobs as long as they have a pager and then they can respond in a certain degree of time," (renal consultant).

Several technological changes can easily be and probably will be implemented, learning from experience and taking advantage of new products now available. These include using the patient's own broadband connection or even a lower cost VirginMedia connection service, using standard resolution video (could be patient owned iPad or smartphone) for patients once they are competent and confident and implementing a call waiting facility.

5.3. Patient selection

Staff noted that there are stringent criteria for patients to be suitable for home dialysis. Some patients do not have space at home, do not have adequate carer support, or simply prefer not to take responsibility for something difficult and potentially risky. There is, however, great interest and desire to have home dialysis with telemedicine support.

"The majority of patients aren't suitable," (renal consultant).

"patients can forget what to do," (renal nurse).

"They'll say, why can't we have it, why is he having it," (renal nurse).

"*The majority are asking why they can't have it when somebody else has got it,"* (renal nurse).

Telemedicine could overcome some of the difficulties for users (around confidence, reminders of processes and ability to self-manage) and may be a way to get more patients into home dialysis.

5.4. Extension of telemedicine to other services

Some obvious opportunities exist to extend the use of the video links across the renal service and potentially to other services. Those noted by staff include:

- Extension to peritoneal dialysis patients (high definition cameras not necessarily required);
- Use within the clinical team for meetings and consultations (already happening);
- Using for consultant led clinics, when a physical examination is not done;
- Use by technicians and multidisciplinary teams.

"You could run a whole clinic on it because a patient can travel a long way to see a doctor one to one. He doesn't always look at the body, he talks about the dialysis problems any issues they may have, what their weight is, and they can actually do their own BP while we're watching," (renal nurse).

However, it was also noted that clinicians gain all sorts of subtle information by seeing a patient face to face and that it cannot always be predicted when a physical examination might be required. Other clinical staff therefore expressed reservations about offering remote consultations.

"*we've got all this support for the haemos, why can't this be offered to the PD patients?"* (renal nurse).

There is clearly also an opportunity to extend to other services that the same patients may need to use. Many renal patients have multiple co-morbidities (eg. diabetes, heart condition) and will also be patients of other consultants at Royal Preston Hospital and may be receiving visits from other

specialist nurses. As they have the kit in their home, it could be used to support self-management of their other conditions.

5.5. New features

The new machines being installed have a telemetry function that can be used to acquire information directly, rather than relying on patients recording it. If this could be fully utilised, significant improvements in understanding patient symptoms could follow, with the possibility of changing dialysis parameters between check-ups.

"They now have real time data with their new machines, which they could make more use of. This records physiological data (blood pressure, arterial and venous pressures, time on machine). Patients are supposed to record this and bring it to consultations, but only 70% do. The real time data means they can monitor compliance, but also they could change machine parameters – for instance, change the pump speed if blood pressure is low" (Renal consultant).

"We can see all that data," (Renal nurse).

"We are electronically getting information directly from the dialysis machine back to our database at hospital," (IT team member).

"the data quality is better so less errors, more accurate," (IT team member).

"if you ask the patient to write down technical data, can you guarantee that's going to be accurate," (IT team member).

The possibility of recording telemedicine consultations (for training and liability protection) with nurses has also been raised, although this would have ethical, privacy and possibly security issues to be addressed.

"Not recording the telemedicine consultation – if they did, it could be used for training purposes, but also to protect liability, did the patient do as they were told to do," (Renal consultant).

5.6. Related work elsewhere

A literature search was performed on the MEDLINE, EBSCO, and CINHAL for studies published from January 1st 2000, until 13th May, 2015. The search strategy used the following keywords: home dialysis, nephrology, videoconferencing, remote, telemedicine.

The work identified included the use of telemedicine for peritoneal dialysis in the home[123], but not for home haemodialysis. Reports were also given of use of telemedicine between regional centres and satellite units[45678]. We conclude therefore that the work at Lancashire Teaching Hospitals is novel and world-leading.

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[1] Gallar P, Vigil A, Rodriguez I, et al. Two-year experience with telemedicine in the follow-up of patients in home peritoneal dialysis. J Telemed Telecare 2007;13:288- 292

2 Mitchell BR, Mitchell JG, Disney AP. User adoption issues in renal telemedicine. J Telemed Telecare 1996;2:81–2

3 Mitchell JG, Disney AP, Roberts M. Renal telemedicine to the home. J Telemed Telecare 2000;6:59–62

[4] Winchester JF, Tohme WG, Schulman KA, et al. Hemodialysis patient management by telemedicine: design and implementation.ASAIO 1997;43:763–6

[5] Moncrief JW. Teledialysis: desktop based video monitoring for hemodialysis patients and delivery of primary care to dialysis patients. Telemed J 1998;4:85

[6] Pierratos A, Ouwendyk M, Francoeur R, et al. Nocturnal hemodialysis: three-year experience. J Am Soc Nephrol 1998;9:859–68

5.7. Cost model

This consultancy exercise did not cover detailed cost and benefit analysis, due to limited time. Much of the information needs to come from the renal service and, due to pressures of work, it was not possible to obtain these within the timescales. However, our conclusion is that a) there are opportunities to reduce the per-patient annual cost, as the current service is over-specified and b) economies of scale have not yet been realised with only 4 units available. Indicative estimates from staff are that a further investment of £30k would enable the benefits of this initial investment to be realised by extending to more patients and giving economies of scale. Ongoing operational costs are being steadily driven down as alternative, lower cost technical solutions are being implemented.

Recommendation for business case development

We propose that further work is done as follows:

1. Identify the potential areas of cost savings identified in 'recommendations for business case development' above (and summarised in section 6 below);
2. Create a model that can be extrapolated if more patients are included;
3. Develop 2-3 scenarios for a larger rollout of telemedicine that can provide some economies of scale:
    a. More haemo patients (what is a realistic maximum figure for Lancs and Cumbria?)
    b. Combine max haemo numbers with a lower spec service using smartphones or tablets for PD and haemo 'super-users'.
    c. Extend to other services that the Trust is already providing to the same patients.

Further investment is likely to be required and there are ongoing running costs for the hosting and maintenance, but costs savings can be identified through economies of scale by judiciously extending the service. It is possible that some contribution to the investment could be secured from one of the relevant charities (British Kidney Patient Association, the National Kidney Federation etc.).

6. Conclusion and recommendations

There is very strong qualitative evidence that telemedicine is making a strong impact on patient experience, empowerment and staff efficiency. Quantitative evidence is hard to uncover and needs some dedicated work to bring this out, but anecdotally there are significant time savings for critical front line staff. The emerging evidence is that telemedicine has the potential to enable more renal patients to be offered home haemodialysis, in line with clinical best practice and NICE guidelines.

Major investments have already been made, through grant funding and use of internal Trust monies. This has proved the concept, but the indication is that some increase in scale is necessary. A business case needs to be made to support this. Our recommendations for the business case development are:

- Identify cost of an emergency unplanned admission. Review how many happen per year and how many could be prevented if telemedicine were available.
- Review patients who have had to discontinue home dialysis and identify any that could be prevented if telemedicine were available.
- Complete the information on the 6 case histories so that comparisons can be made of the care provided to patients receiving telemedicine and those not receiving it.

[7] Agroyannis B, Fourtounas C, Romagnoli G, et al. Telemedicine technology and applications for home hemodialysis. Int J Artif Organs 1999;22:679–83

[8] Winchester JF, Levine B, Collman J, et al. Telemedicine: future promise for dialysis management. Semin Dial 1999;12 (Suppl. 1):101–3

- Start to record video calls by maintenance team and any benefits. Analyse site visit records and review which could have been avoided using telemedicine.
- Create a model that can be extrapolated if more patients are included.
- Develop 2-3 scenarios for a larger rollout of telemedicine that can provide some economies of scale.

We also strongly recommend that the Service moves as quickly as possible to using integrated digital patient records, that can be updated from any device at any location by any staff member. This would not only help in business case development for this and other service improvements, but it would reduce staff workload. We realise this is a difficult task to implement within the NHS, but would note that current practices may place patients and the Trust at risk if patient safety is compromised by critical information not being available when needed.

Lancashire Teaching Hospitals Trust is already exceeding national averages for numbers of patients receiving home dialysis and is actively looking for ways to use technology to increase these numbers further. Staff and partners should continue to promote and disseminate this activity, both internally and externally.

Finally, if it is thought to be useful to the development of the service, a larger and more in depth research study on patient attitudes and benefits could be commissioned.

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