

Ditchburn, Jae-Llane ORCID: <https://orcid.org/0000-0002-7499-6790> and Marshall, Alison ORCID: <https://orcid.org/0000-0001-6816-2362> (2017) Renal telemedicine through video-as-a-service delivered to patients on home dialysis: a qualitative study on the renal care team members' experience. *Journal of Renal Care*, 43 (3). pp. 175-182.

Downloaded from: <http://insight.cumbria.ac.uk/id/eprint/2933/>

Usage of any items from the University of Cumbria's institutional repository 'Insight' must conform to the following fair usage guidelines.

Any item and its associated metadata held in the University of Cumbria's institutional repository Insight (unless stated otherwise on the metadata record) may be copied, displayed or performed, and stored in line with the JISC fair dealing guidelines (available [here](#)) for educational and not-for-profit activities

provided that

- the authors, title and full bibliographic details of the item are cited clearly when any part of the work is referred to verbally or in the written form
 - a hyperlink/URL to the original Insight record of that item is included in any citations of the work
- the content is not changed in any way
- all files required for usage of the item are kept together with the main item file.

You may not

- sell any part of an item
- refer to any part of an item without citation
- amend any item or contextualise it in a way that will impugn the creator's reputation
- remove or alter the copyright statement on an item.

The full policy can be found [here](#).

Alternatively contact the University of Cumbria Repository Editor by emailing insight@cumbria.ac.uk.

Renal telemedicine through video-as-a-service delivered to haemodialysis patients at home: a qualitative study on the renal care team members' experience

Jae-Llane Ditchburn^a and Alison Marshall^b

- a. Science, Natural Resources and Outdoor Studies, University of Cumbria, UK
- b. Cumbrian Centre for Health Technologies (CaCHeT), University of Cumbria, UK.

Corresponding author:

Jae-Llane Ditchburn

Science, Natural Resources and Outdoor Studies, University of Cumbria, CA1 2HH
UK

Email: jae-llane.ditchburn@cumbria.ac.uk

ABSTRACT

Background: The Lancashire Teaching Hospitals NHS Trust has been providing renal care through video-as-a-service (VAAS) to patients since 2013, with support from the North West NHS Shared Infrastructure Service, a collaborative team that supports information and communication technology use in the National Health Service.

Introduction: Renal telemedicine offered to patients on home dialysis remotely supports renal care through the provision of a live high quality video link directly to unsupported haemodialysis patients at home. Home haemodialysis is known to provide benefits to patients, particularly in making them more independent. The use of a telemedicine video-link in Lancashire and South Cumbria further reduce patient dependence on the professional team.

Objective: The purpose of this paper is to present the perspectives of the renal care team members using the renal telemedicine service to understand the perceived benefits and issues with the service.

Method: Ten semi-structured interviews with members of the renal care team (2 renal specialists, 1 matron, 2 renal nurses, 1 business manager, 1 renal technical services manager, 2 IT technicians and 1 hardware maintenance technician) were conducted. Thematic analysis was undertaken to analyse the qualitative data.

Results: A range of incremental benefits to the renal team members were reported, including more efficient use of staff time, reduced travel, peace of mind and a strong

sense of job satisfaction. Healthcare staff believed that remote renal care through video was useful, encouraged compliance and could nurture confidence in patients. Key technological issues and adjustments which would improve the renal telemedicine service were also identified.

Conclusion: The impact of renal telemedicine was positive on the renal team members. The use of telemedicine has been demonstrated to make home dialysis delivery more efficient and safe. The learning from staff feedback could inform development of services elsewhere.

(292 words)

Keywords: qualitative research, telehealth, telemedicine, communications, home haemodialysis, delivery of health care, telecare

INTRODUCTION

Chronic kidney disease affects approximately 6% of the UK adult population. The number of people affected with the disease is increasing. According to the UK Renal Registry, 56,940 people received renal replacement therapy in 2013, compared to 54,725 people in the previous year. It is mild in the majority of people affected but can cause serious health complications such as anaemia, fluid retention and decreased immune response, making them more susceptible to illness (The National Kidney Foundation, 2015).

Lifestyle changes such as selective diet and performing suitable forms of exercise are recommended for people affected with kidney problems (Painter, 1994; Sarnak *et al.*, 2005). Two major outcomes of chronic kidney disease are progressive loss of kidney function over time, and progression of cardiovascular disease (Go *et al.*, 2004). Treatment may involve the use of medications, and undergoing haemodialysis or peritoneal dialysis (Mactier *et al.*, 2011). The choice of haemodialysis or peritoneal dialysis depends on patient factors and circumstances. Peritoneal dialysis uses the lining of the abdominal cavity and a solution to remove wastes and extra fluid from the body whereas a man-made membrane is used for this purpose in haemodialysis. Haemodialysis is therefore more complex and a highly risky intervention. Patients receiving haemodialysis may need to travel to hospital up to three times a week for treatment that can take up to four hours at a time. The option of home haemodialysis is available to some patients, who are stable and have appropriate domestic circumstances. Expensive equipment must be installed at the home (with some modification to the building) and patients and carers need to learn to use it correctly. Risks include infection, blood loss, low blood

pressure and air bubbles in the patient lines (The National Kidney Foundation, 2015).

The Renal Association recommends that information and education about home haemodialysis should be provided to patients who may be suitable. Guideline 9.3 recommends “self-treatment at home as the best way to perform daily short or daily nocturnal haemodialysis”. Training in dialysis is essential for patients who are eligible due to the complexity and risks that come with performing dialysis at home. It should also be held for patients at a regional centre if training is not available in their local areas (Mactier *et al.*, 2011). Among the eligibility criteria for home dialysis are that patients who are stable on dialysis, should have good vascular access and be free from complications and significant concomitant diseases that would be unsafe for home dialysis (Castledine *et al.*, 2014). After patients have been trained at a regional centre until they are confident and deemed competent to do home dialysis, they are supported by a Community Renal Nurse. Typically, the Community Renal Nurse will visit and stay with the patient through their first few home sessions and be available on call thereafter.

According to the UK Renal Registry, approximately 4% of renal patients on haemodialysis carry out the treatment at home. The overall percentage of patients receiving home dialysis has increased from 3.4% in 2011 to 4.1% in 2013. The National Institute of Health Care and Excellence (NICE) has estimated that 10 to 15% of suitable dialysis patients would choose the option for home dialysis if it was offered to them, indicating a need for a service to support patients on home haemodialysis. It is here that telemedicine comes in because of its potential in supporting patients carrying out dialysis at home, reducing dependence on community renal nurses.

Telemedicine can be described as the delivery of health care from a provider to the patient through the use of digital technologies such as telecommunication devices and videoconferencing (Wootton, 1998; Sood *et al.*, 2007).

Previous studies have documented renal telemedicine delivered to patients in satellite dialysis centres linked to a reference hospital (Whitten & Buis, 2008) as well as patients performing the much less risky peritoneal dialysis at home (Mitchell *et al.*, 2000). In Whitten and Buis (2008), patients used renal telemedicine from satellite centres linked to a reference hospital in Michigan. Thirty-four patients and four healthcare staff answered telephone surveys, of which consisted eleven open-ended questions and fourteen Likert-type scale questions, and three yes/no questions related to ICT use. They found that patients generally had positive perceptions of using the renal telemedicine service from satellite centres although there were some reservations on whether the service should only be used when a healthcare professional could not be physically present. Although telemedicine in this study was not related to patients performing dialysis at home, healthcare staff welcomed the use of renal telemedicine for consultations and felt that it had potential to enhance the care being delivered to patients. In South Australia, Mitchell, Disney and Roberts (2006) reported a case study based on a renal patient who performed dialysis at home and received medical care through a video link. Their findings showed that the delivery of renal telemedicine was successful in reducing frequent hospital admissions for the patient. There was also favourable report from healthcare staff of providing support to the patients without having to travel and on potential savings in reducing hospital re-admissions. In the United Kingdom, Cargill and Watson (2003) highlighted the advantages of using the videophone in delivering support to child

patients on home peritoneal dialysis despite its high costs. In Spain, Gallar and colleagues examined the use of telemedicine in patients undergoing peritoneal dialysis. Twenty-five patients on peritoneal dialysis were managed by telemedicine and the control group consisting of thirty-two were managed without telemedicine. Those in the telemedicine group reported an improvement in quality of life in 90% of cases. Hospital re-admissions were also lower in the telemedicine group. Hence, evidence in the literature on renal telemedicine has so far been promising.

Renal telemedicine service at Lancashire Teaching Hospitals

The regional Renal Centre at Lancashire Teaching Hospitals started providing a renal telemedicine service to eligible patients in 2013. The main renal unit at Preston serves patients cross Lancashire and South Cumbria, covering an area of 4,515 square kilometres, catering to a population of 1.4 million people (Cumbria Intelligence Observatory, 2016). The renal telemedicine service works by providing a live video link between the patient's home and the main renal unit at Preston, meaning that the patient is in contact remotely with a nurse or doctor whilst undergoing dialysis at home. The technology chosen is Video-as-a-Service, which is provided as a lease option including support and maintenance by the supplier. The digital interface enables remote access to patients by using Polycom® video technology through a rotating PTZ (pan, tilt, zoom) camera and a high-definition screen at the patient's home, to ensure the best image quality possible (Polycom, 2015). [The equipment used is constantly being updated to meet patient needs.](#) [Operational costs of the service are not disclosed here due to continuous changes since the implementation of the service. Nevertheless, the authors may be able to](#)

facilitate an introduction to the renal team at Lancashire Teaching Hospitals for any interested persons or parties.

Eligible patients are given detailed training for three months at the hospital before they can dialyse at home. Having video-as-a-service saves the patient from having to travel long distances for routine appointments and check-ups (Chugh *et al.*, 1999). Previously, a patient also needed to dial into the main hospital line and wait while nurses were alerted to take their calls. However, by using the renal telemedicine service, patients are now able to contact the renal care team directly and avoid waiting. With the patient's consent, the renal telemedicine system allows the specialist renal care team to remotely access and subsequently monitor vital data from the dialysis machine at the patient's home. At present, seven patients have used the service.

Renal nurses and consultants have been the main professionals providing dialysis nursing care to patients with established chronic kidney disease (Polaschek, 2003), supported by technicians and clinical administrators (British Renal Society, 2002). The multi-professional team also has an important role in ensuring that any transitions of care experienced by patients are smooth_ (Davies *et al.*, 2001). This paper seeks to investigate their experiences with the renal telemedicine service, the impact of the technology on them, and their opinions on how the service could be made better.

METHOD

Participants

Ten members of the Lancashire Teaching Hospitals renal team comprising two renal specialists, one matron, two renal nurses, one business manager, one renal technical services manager, two IT technicians and one hardware maintenance technician) were interviewed. The study was approved by Clinical Renal Director of the Lancashire Teaching Hospitals NHS Trust as a service evaluation (NHS Health Research Authority, 2013). The approach used was the Stakeholder Empowered Adoption Model (Marshall, 2013), which involves engagement with all key stakeholders to understand barriers to and enablers of adoption. The Model draws on the more theoretical Normalization Process Theory (May & Finch, 2009) and the Technology Acceptance Model (Venkatesh & Davis, 2000) and provides a practical framework to identify and collect appropriate evidence for decision-making. Semi-structured interviews were conducted to understand and identify stakeholders' viewpoints of barriers to and benefits from using the renal telemedicine service with the aim of aiding adoption on the technology, and to support decision-making for Lancashire Teaching Hospitals. Participation in the interviews was voluntary. Informed and written consent was obtained from the study participants.

Data collection

Ten semi-structured interviews were conducted (see Appendix A for interview schedule). Each interview lasted approximately 45 minutes. Interviews were audio-recorded and fully transcribed. All collected data was kept and stored in compliance with the UK Data Protection Act 1998 (ICO, 2015). In this paper, data is presented verbatim and should be viewed as illustrative rather than generalizable. The following issues were explored: team members' initial thoughts and expectations of the renal telemedicine service, perceptions on the usability of renal telemedicine, the

impact of renal telemedicine on them as a renal team member, and opinions about the service.

Data analysis

An **inductive approach** (Thomas, 2006) was used to analyse the data using a constant comparative method. The data was transcribed verbatim and the transcripts were reviewed to identify themes following the six-stage thematic approach outlined by Braun and Clarke (Braun & Clarke, 2006). The data was double-coded. Both authors refined code definitions reducing categories to major themes through on-going discussions and the re-reading of transcripts until unanimous agreement was reached.

RESULTS

Members of the renal team believed that the renal telemedicine service was useful, encouraged compliance and could nurture confidence in patients. The technology was well-received. Six major themes were generated from the qualitative data: (i) positive feedback from patients, (ii) quicker way to solve problems, (iii) more efficient use of staff time, (iv) reduced travel, (v) peace of mind, and (vi) sense of job satisfaction. Suggestions to improve the service were to include multiple calls per video line instead of having only one live video communication at a single time, and to alleviate delays in the installation of equipment or broadband connection at the patient's home.

Perceived positive feedback from patients

Members of the renal team reported positive feedback from patients and commented on seeing their patients becoming more confident in performing their dialysis at home. Staff also observed that patients were able to change their dialysis pattern to something that was more convenient for them, for example to dialyse for 1-2 hours per day, instead of 4-5 hours twice a week.

“This guy [referring to a patient] is carrying his life on as normal instead of using half a day two or three times a week to travel,” (renal services manager).

Quicker way to solve problems

The videoconferencing feature using high definition visual technology in the renal telemedicine service allowed healthcare staff to respond quickly and efficiently to patients experiencing issues whilst dialysing. Patients were able to connect directly to the renal unit through the videoconferencing link.

“That’s when it would be ideal to beam in on what the problem is, you can see and you can direct at it straight away,” (renal nurse).

“I’ve witnessed two events where one – the needle popped out and blood was 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, 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 [referring to renal telemedicine system],” (renal technical services manager).

Nurses also commented that renal telemedicine could help in reducing re-admissions to hospital if they were able to remotely see and advice the patient at the moment the problem was happening.

“Have they got a cloudy bag, yes show me,” (renal nurse).

“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).

More efficient use of staff time

Nurses could continue to monitor the progress of their patients dialysing at home whilst based at the nurses’ station, thus allowing them more efficient use of their time. Communicating directly with the patient also frees up more time for the nurses to perform other tasks.

“Previously a nurse would be with the patient full time for their first three days of home dialysis. Now it may only be one day,” (renal matron).

There were significant recruitment and retention issues to these specialist renal nurse roles and the team experienced stress, with a high incidence of sickness leave, so this aspect was particularly valuable to managers and to staff.

Peace of mind

Healthcare staff, particularly the nurses, found that using the renal telemedicine system helped in alleviating their worries and concerns about their patients. The renal telemedicine system existed as a “safety net” in which patients dialysing at home were still remotely connected to their renal care team, whilst still allowing the renal care team to monitor the progress of the patient.

One nurse mentioned that she was able to fit in other bits of work whilst her patients were dialysing due to the direct, real-time visual contact provided through the videoconferencing link.

“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 [referring to a patient currently on remote dialysis] and do some work on the computer, finish my emails off, desk work,” (renal nurse).

Reduced travel

Using the videoconferencing link helped to reduce unnecessary travel for nurses and maintenance visits by technicians.

“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 technician).

This also enabled the nurses to extend their support to other home dialysis patients, because they had confidence to leave the telemedicine patient to manage alone.

Sense of job satisfaction

Members of the renal team felt that their work with patients through renal telemedicine was meaningful and gratifying. Renal nurses also commented that using renal telemedicine allowed them to do their job better. Using renal telemedicine link made it easier for them to support their patients. Nurses also felt

that the videoconferencing link enhanced the current renal dialysis service at the hospital.

“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).

Suggestions for improvement

The renal nurses suggested that the service would benefit from having a multiple caller waiting feature. Currently, the technology in use facilitates only one-to-one live videoconferencing which means that nurses are unable to know if another patient is trying to contact them, unless the patient dials the main hospital telephone line. A multiple caller waiting feature could also reassure patients that the communication channel was working, and that they would be attended to.

Managers were aware that the relatively low numbers meant that it was difficult to operationalise the service effectively. Technical and other support had to be provided as special cases. There was a desire from some managers to scale up the service so that economies of scale could be realised.

Further work was also thought to be needed to mitigate delays in video-conferencing equipment installation and commissioning at patients' homes. This was important to ensure a smooth transition from hospital and continuity in self-management by the patient.

The technical team wished to further experiment with lower quality cameras for the very stable and capable patients. Such cameras are available at much lower cost and could enable the high quality equipment to be moved on to new users.

DISCUSSION

Our qualitative interviews showed that the live video-link to support home haemodialysis was valued by the renal care team. The use of the technology was well-accepted, particularly among the nurses. The positive feedback about patients using the renal telemedicine service from the renal care team members suggested that having the videoconferencing link was helpful and supportive to patients dialysing at home. This is speculative of an enhanced patient experience supported by telemedicine, as reported in Gallar and colleagues (2007). The digital proximity through videoconferencing was important in helping to establish trust with and support for the patients.

Obtaining a comprehensive description of operational problems faced by patients performing dialysis at home is particularly urgent due to the risks associated with haemodialysis. The renal nurses reported that by using the renal telemedicine technology they were able to quickly intervene with patients because they could visualise the issues faced by the patient, for example zooming into the fistula or the dialysis machine, and help the patient solve problems quickly. This visual feature of renal telemedicine is similar to Lindberg et al. (2009) which documented paediatric nurses' experience with videoconferencing between a neonatal unit and the families' home. The nurses found that videoconferencing helped them to assess the overall situation at home and facilitated the relationship between parents and the infant. They felt that they were able to provide security to the family (Lindberg *et al.*, 2009), similar to the availability of a "safety net" described in our qualitative interviews with the renal care team. The enablement of quick problem-solving through videoconferencing is also evident in other telemedicine-related areas. In a similar

context, Bidmead and colleagues reported quicker swallowing assessments and shorter waiting times for older people living in care homes who received assessments via telemedicine delivered to them (Bidmead *et al.*, 2015).

Clinicians' time is valuable and can be costly (Waldman *et al.*, 2004; Mark *et al.*, 2009; Finkelstein *et al.*, 2006). The technology enabled the renal care team to provide improved services in which coordination with different professionals were made possible in ways before the renal telemedicine service connections were available. Our results suggest savings in time, meaning that nurses could fit in caring for other patients and perform related tasks. The evidence from our study presented so far supports the potential for significant cost savings in using renal telemedicine (Waldman *et al.*, 2004; Finkelstein *et al.*, 2006). Finkelstein and colleagues reported lower healthcare costings in the delivery of home healthcare through telemedicine where costs were lowest in patients receiving virtual visits through videoconferencing technology, compared to those receiving traditional nursing care at home and those receiving traditional nursing care, virtual visits and physiologic monitoring for their long term health conditions. Vitacca and colleagues (2009) evaluated reduction in hospitalisations and exacerbations, general practitioner (GP) calls and related cost-effectiveness of teleassistance for patients with chronic obstructive pulmonary disease (COPD) randomised into either an intervention group receiving teleassistance or a control group receiving traditional care. One of their findings was the greater advantage in the intervention group where the average overall cost of each patient was 33% less than that for usual care, despite deducting costs for nurse teleassistance.

Interviews with the renal care team have illustrated the importance of having peace of mind at work, in particular, amongst the renal nurses. Healthcare professionals frequently encounter situations in which requires them to take responsibility for their patients, many of which can be emotionally trying, as is common to the nursing profession (Svensson & Fridlund, 2008; Sherman, 2004). Emotional labour experienced by healthcare staff increases perceptions of job stress, decreases satisfaction and increases distress (Pugliesi, 1999). Therefore, work conditions that promote better emotional wellbeing will contribute to the emotional and physiological welfare of healthcare staff (Motowidlo *et al.*, 1986). The authors conclude that using the videoconferencing technology in renal telemedicine has potential in alleviating occupational job stress amongst healthcare staff.

Whilst there is no evidence here to show any associations between peace of mind and sense of job satisfaction, our findings suggest that using the videoconferencing link enhanced patient–healthcare staff relations in working together to support the dialysis journey of the patient, and identify and solve any issues experienced by the patient. The impact of the technology on the patients could be seen by the healthcare staff who supported them and noticed differences in patients’ attitudes. Those using renal telemedicine seemed to be more engaged in self-care and management of their renal treatments (McCarley, 2009) and have favourable attitudes towards performing dialysis at home (Morton *et al.*, 2011). [This study has found conclusive evidence for the following implications for practice \(presented in Table 1\).](#)

[Table 1. Implications for practice – the potential of renal telemedicine](#)

1. Beneficial approach to serving eligible renal patients
2. Improvement in staff productivity associated with better use of time
3. Reduction in hospital re-admissions
4. Reduction in staff travel costs to visit patients at home
5. Reduction in patient travel costs to attend hospital appointments
6. Increase in outpatient capacity at the renal centre
7. Provides faster response to issues, including potential emergencies, faced by patients dialysing at home
8. Shortened length of dialysis training for patients undergoing home-based haemodialysis therapy
9. A shift to remote renal care is a shift in self-care for patients
10. Addressing staff concerns is likely to improve service delivery to patients

LIMITATIONS

The study must be considered in light of its limitations. Whilst this paper focused on the perceptions of healthcare staff in the delivery of the renal telemedicine service, it did not include patients' perceptions and experience of the renal telemedicine service. Although a qualitative approach was undertaken for this study, it would have been useful to have complemented it with some quantitative outcome measures such as the number of remote consultations, hospital visits and cost analyses. Although the results are based on a small sample size, our findings so far have shown consistency in comparison to other qualitative renal telemedicine-related studies.

CONCLUSION

Overall, the renal telemedicine technology was favourably received by the renal care team. The technology has had positive impacts on the multi-professionals involved in

the delivery of the renal telemedicine service. Renal telemedicine was instrumental in helping patients to look after themselves and gain confidence in the course of their treatment on renal dialysis (for example, patients learning how to needle themselves and look after their arteriovenous fistula).

Our study findings demonstrate that it is feasible to provide remote supervision and support to renal patients eligible for undergoing dialysis at home. The study has found evidence to suggest that the technology used in renal telemedicine can enhance staff efficiency and patient care. Healthcare staff suggestions for improvement of the current renal telemedicine service at Lancashire Teaching Hospitals should be taken into consideration for future expansion of the service. Our findings support the view that renal telemedicine is a good option for eligible patients undergoing dialysis at home. [Future work on renal telemedicine should be extended to patient experience in using the service. The investigation could be compared to control group of renal patients attending dialysis sessions in renal centres. A detailed study of operational costs would also inform the adoption and implementation of renal telemedicine in future.](#)

(3,905 words)

FUNDING

This study was funded by the North West Shared infrastructure Services (NWSIS) which supports information and communications technology use in National Health Service (NHS) organisations across Lancashire.

ACKNOWLEDGEMENTS

The authors wish to thank Scott Rayner for helping to arrange interview sessions with the study participants, John Slater for a demonstration of the renal telemedicine link between a patient home's and hospital, Gus Hartley and Ian Kinder for explaining technical details about the renal telemedicine service and Dr Ajay Dhaygude for his comments on the manuscript.

CONFLICT OF INTEREST.

None.

References

Bidmead, E., Reid, T., Marshall, A. & Southern, V. (2015) 'Teleswallowing: a case study of remote swallowing assessment', *Clinical Governance: An International Journal*, 20 (3), pp.155 - 168.

Braun, V. & Clarke, V. (2006) 'Using thematic analysis in psychology', *Qualitative Research in Psychology*, 3 (2), pp.77-101.

British Renal Society. (2002) *The renal team: a multi-professional workforce plan for adults and children with renal disease. Recommendations of the National Renal Workforce Planning Group*. Available at:

<https://www.rcplondon.ac.uk/sites/default/files/renal-medicine-census-2010.pdf>

Castledine, C., Davenport, A., Dawnay, A., Farrington, K., Fogarty, D., Kumwenda, M., MacPhee, I., Ravanan, R., Roderick, P., Sinha, M.D. & Williams, A.J. (2014) 'UK Renal Registry. 17th Annual Report of the Renal Association.', *Nephron Clinical Practice*, 129 (Suppl. 1),

Chugh, K.S., Jha, V. & Chugh, S. (1999) 'Economics of dialysis and renal transplantation in the developing world', *Transplantation Proceedings*, 31 pp.3275 - 3277.

Cumbria Intelligence Observatory. (2016) *Cumbria Joint Strategic Needs Assessment*. Available at:

<http://www.cumbriaobservatory.org.uk/elibrary/Content/Internet/536/671/4674/5359/5360/4123412228.pdf>

Davies, S., Van Biesen, W., Nicholas, J. & Lameire, N. (2001) 'Integrated care', *Peritoneal Dialysis International*, 21 (Suppl 3), pp.S269-S274.

Finkelstein, S.M., Speedie, S.M. & Potthoff, S. (2006) 'Home telehealth improves clinical outcomes at lower cost for home healthcare', *Telemedicine Journal & E-Health*, 12 (2), pp.128-136.

Go, A.S., Chertow, G.M., Fan, D., McCulloch, C.E. & Hsu, C. (2004) 'Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization', *New England Journal of Medicine*, 351 (13), pp.1296-1305.

ICO. (2015) *Data protection act*. Available at: <https://ico.org.uk/about-the-ico/what-we-do/data-protection-act/>

Lindberg, B., Axelsson, K. & Ohrling, K. (2009) 'Experience with videoconferencing between a neonatal unit and the families' home from the perspective of certified paediatric nurses', *Journal of Telemedicine and Telecare*, 15 (6), pp.275-280.

Mactier, R., Hoenich, N. & Breen, C. (2011) 'Renal Association Clinical Practice Guideline on haemodialysis', *Nephron.Clinical Practice*, 118 Suppl 1 pp.c241-86.

Mark, B.A., Lindley, L. & Jones, C.B. (2009) 'Nurse working conditions and nursing unit costs', *Policy, Politics & Nursing Practice*, 10 (2), pp.120-128.

Marshall, A. (2013) 'Designing telemedicine apps that health commissioners will adopt.', in 'Designing telemedicine apps that health commissioners will adopt.', *Proceedings of the 14th Conference of the Open Innovations Association (FRUCT)*. 11- 15 November. Finland: IEEE., pp.63 - 68.

May, C. & Finch, T. (2009) 'Implementing, embedding, and integrating practices: an outline of normalization process theory', *Sociology*, 43 (3), pp.535 - 554.

McCarley, P. (2009) 'Patient empowerment and motivational interviewing: engaging patients to self-manage their own care', *Nephrology Nursing Journal*, 36 (4), pp.409-413.

Mitchell, J.G., Disney, A.P. & Roberts, M. (2000) 'Renal telemedicine to the home', *Journal of Telemedicine and Telecare*, 6 (1), pp.59-62.

Morton, R.L., Tong, A., Webster, A.C., Snelling, P. & Howard, K. (2011) 'Characteristics of dialysis important to patients and family caregivers: a mixed methods approach', *Nephrology, Dialysis, Transplantation : Official Publication of the European Dialysis and Transplant Association - European Renal Association*, 26 (12), pp.4038-4046.

Motowidlo, S.J., Packard, J.S. & Manning, M.R. (1986) 'Occupational stress: its causes and consequences for job performance.', *Journal of Applied Psychology*, 71 (4), pp.618.

NHS Health Research Authority. (2013) *Defining research. NRES guidance to help you decide if your project requires review by a research ethics committee*. Available at: <http://www.hra.nhs.uk/documents/2013/09/defining-research.pdf>

Painter, P. (1994) 'The importance of exercise training in rehabilitation of patients with end-stage renal disease', *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation*, 24 (1 Suppl 1), pp.S2-9; discussion S31-2.

Polaschek, N. (2003) 'Negotiated care: a model for nursing work in the renal setting', *Journal of Advanced Nursing*, 42 (4), pp.355-363.

Polycom, I. (2015) *Realpresence Platform*. Available at: <http://www.polycom.co.uk/products-services/realpresence-platform.html>

Pugliesi, K. (1999) 'The consequences of emotional labor: Effects on work stress, job satisfaction, and well-being', *Motivation and Emotion*, 23 (2), pp.125-154.

Sarnak, M.J., Greene, T., Wang, X., Beck, G., Kusek, J.W., Collins, A.J. & Levey, A.S. (2005) 'The effect of a lower target blood pressure on the progression of kidney disease: long-term follow-up of the modification of diet in renal disease study', *Annals of Internal Medicine*, 142 (5), pp.342-351.

Sherman, D.W. (2004) 'Nurses' Stress & Burnout: How to care for yourself when caring for patients and their families experiencing life-threatening illness.', *AJN the American Journal of Nursing*, 104 (5), pp.48-56.

Sood, S., Mbarika, V., Jugoo, S., Dookhy, R., Doarn, C.R., Prakash, N. & Merrell, R.C. (2007) 'What is telemedicine? A collection of 104 peer-reviewed perspectives and theoretical underpinnings', *Telemedicine and E-Health*, 13 (5), pp.573-590.

Svensson, A. & Fridlund, B. (2008) 'Experiences of and actions towards worries among ambulance nurses in their professional life: A critical incident study', *International Emergency Nursing*, 16 (1), pp.35-42.

The National Kidney Foundation. (2015) *Home Haemodialysis Frequently Asked Questions*. Available at: <http://www.kidney.org.uk/assets/BRSHome-dialysis-FAQs-June-15.pdf>

Thomas, D.R. (2006) 'A general inductive approach for analyzing qualitative evaluation data', *American Journal of Evaluation*, 27 (2), pp.237-246.

Venkatesh, V. & Davis, F.D. (2000) 'A theoretical extension of the technology acceptance model: Four longitudinal field studies. ', *Management Science*, 46 (2), pp.186 - 204.

Waldman, J.D., Kelly, F., Aurora, S. & Smith, H.L. (2004) 'The shocking cost of turnover in health care', *Health Care Management Review*, 29 (1), pp.2-7.

Whitten, P. & Buis, L. (2008) 'Use of telemedicine for haemodialysis: perceptions of patients and health-care providers, and clinical effects', *Journal of Telemedicine and Telecare*, 14 (2), pp.75-78.

Wootton, R. (1998) 'Telemedicine in the National Health Service', *Journal of the Royal Society of Medicine*, 91 (12), pp.614-621.

APPENDIX A: Semi-structured interview questions

1. What are your roles and responsibilities with regards to renal patients?
2. Thinking back to when you first heard about the telemedicine system, what were your thoughts? What were your feelings?
3. Now that the renal telemedicine service is in place, what are your thoughts about using it?
4. Thinking about your experience, what are the impacts on you from using the renal telemedicine service?
5. Thinking about patients, what are the impacts of using the renal telemedicine service?
6. Thinking about your department/service, what are the impacts of using the renal telemedicine service?
7. What are the benefits of the renal telemedicine service?
8. What are the problems, if any? What are your concerns?
9. Is there anything else you would like to mention?