Implementation of a pre-dialysis clinical pathway for patients with chronic kidney disease

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Abstract

Objective. The objective of this study was to design and implement an efficient pathway to ensure a smooth transition of patients with advanced chronic kidney disease to dialysis.

Setting. In our dialysis service, as elsewhere, we recognized that there was an unacceptably high rate of inadequately prepared patients commencing dialysis. Knowledge of clinical practice and research-based guidelines has not in itself changed clinical practice and patient management.

Main measures. To address these problems, multidisciplinary process redesign teams reviewed pre-existing arrangements by assessing current practice. The review identified critical points where problems could occur: failure to notify patients to dialysis service, late referral for vascular surgery, and inadequate pre-dialysis education. As a result of this process, we have formulated a modified and coordinated pre-dialysis programme.

Results. In association with process redesign, the proportion of patients registered ‘late’ decreased from 29% in July–September 2000 (pre-implementation) to 6% in January–March 2004 (P < 0.01) with the corresponding median time from registration to commencement of dialysis increasing from <1 month to 14 months (P < 0.01). Patients not registered with the service decreased from 57 to 0% (P < 0.001). Eighty-three per cent of patients commenced dialysis with a permanent vascular access in January–March 2004, compared with 24% in July–September 2000 (P < 0.001).

Conclusions. Through process redesign, more of our patients are known to us before commencement of dialysis, a greater proportion of which are provided with pre-dialysis education and permanent vascular access. Our results highlight that implementation remains the final and most difficult challenge of the guideline process.

Keywords: chronic kidney disease, dialysis, evidence-based care, guideline implementation, referral

Appropriate management of chronic kidney disease in the pre-dialysis phase has a substantial impact on patient outcome. Numerous studies have shown that late referral and late preparation for dialysis result in worse outcomes including poor early survival, increased hospitalization rates, less provision of adequate access and lower quality of life, especially if dialysis commencement was unplanned [1,2].

The North West Dialysis Service (NWDS) provides both haemodialysis and peritoneal dialysis to over 600 patients over a large geographical area. Operating as a hub and spoke model, the NWDS provides dialysis care for patients at home or in satellite units up to 600 km from the base at The Royal Melbourne Hospital. Over the service, 22 nephrologists, each with their own clinical approach, deliver outpatient care in three different models—entirely as private patients in consulting rooms, a mixture of private and state-funded hospital outpatient care, or solely in state-funded hospital outpatient clinics—the last encompassing only 10% of patients entering the NWDS programme. The nephrologists therefore, in the main, are not part of the NWDS. Furthermore, like dialysis services worldwide, the NWDS has seen rapid growth (approximately 6%/annum) in patient numbers.

In our dialysis service, as elsewhere, we increasingly recognized that there was an unacceptably high rate of inadequately prepared patients commencing dialysis. Despite the generally recognized problems associated with late preparation, knowledge of clinical practice guidelines and research-based recommendations is often not sufficient to ensure implementation of...
such guidelines. Clearly, simply identifying problems and disseminating the guidelines has not in itself sufficiently changed clinical practice and patient management [3]. An adequate understanding of the problem, the target group, its setting, and the obstacles involved are required to implement change [4].

Barriers to successful implementation are multifactorial and include amongst others, lack of awareness, lack of agreement, little expectancy of improved outcomes, and inertia [5]. Most research agrees that multifaceted interventions targeting different barriers to change are more likely to be more effective than single interventions, suggesting that we need an integrated strategy to improve our preparation of patients with chronic kidney disease for end-stage renal disease management.

In this article, we therefore describe one successful approach to design, implement, and evaluate an integrated pre-dialysis management plan for patients with near end stage kidney disease. The objective was to achieve earlier notification by nephrologists or internists of each patient to the dialysis service, and hence better planning, with a higher proportion of patients commencing haemodialysis with permanent dialysis access. This initial study does not formally address the other important issue of late referral of chronic kidney disease patients by general practitioners to nephrologists, though the principles might be similar. In this article, we have used the term ‘nephrologist’ to generally refer to internists who have a special interest in nephrology but usually practice mainly as general internists.

Methods

NWDS

Faced by the challenge of increasing patient numbers, geographical diversity, and the various models of care, the NWDS recognized that there was an unacceptably high rate of inadequately prepared patients commencing dialysis, highlighting the need for process redesign.

Process improvement

Review and audit. In early 2000, the NWDS undertook to review and audit the current clinical care pathway for pre-dialysis patients (stage 3 and stage 4 chronic kidney disease) [6]. Our analysis was confined to patients with chronic kidney disease. It did not examine patients presenting acutely, having never seen a physician associated with the NWDS.

This was the first stage of our process improvement, the purpose being to collect and examine baseline data on current practice, to identify bottlenecks, and to plan the process redesign (Figure 1). Wherever possible, the current practice baseline data were benchmarked against local [Caring for Australians with Renal Impairment (CARI)] [7] and American [Kidney Disease Outcomes Quality Initiative (KDOQI)] [8] clinical practice guidelines to ensure evidence-based best practice.

To facilitate the process, an initial step was to define a number of easy to measure key indicators that could be used to directly and indirectly evaluate patient management. These were:

1. An estimated GFR (eGFR in mL/min). eGFR forms the basis for the classification of chronic kidney disease [6], and is common across Australian centres. eGFR was approximated from the formula of Cockcroft–Gault [9] for calculated creatinine clearance, using the following calculations: eGFR = [(140 - age) x weight (kg)] / 814 x serum creatinine (mmol/l) for males, the final result multiplied by 0.85 for females.
2. The number and proportion of patients known to NWDS at commencement of dialysis.
3. Attendance at patient education sessions.
4. The number and proportion of patients commencing with permanent access.
5. The time between registration with the NWDS and commencement of dialysis.

This review identified three critical points where blocks, waste, or risk occurred: notification of patients to service, pre-dialysis education, and vascular access. Specific multidisciplinary process improvement teams (PITs) were established to evaluate each of three issues.

PITs

The objective of these teams was to improve the passage of patients and information through the pre-dialysis system. To achieve this, teams concentrated on measuring outcomes, pathway mapping, and redesign to remove blockages, waste, and risk and developing recommendations and strategies for implementation.
Each team had a senior manager from the NWDS as well as appropriate physicians, surgical, nursing, social work, and ancillary personnel. In each case, the team was guided and supported by a trained facilitator, selected by senior management and trained through a facilitator-training programme.

Teams met on a regular basis for collection and analysis of data, process evaluation, and the formulation of recommendations. Teams used Gantt charts as a planning tool to represent the timing of tasks required for completion of a project. A horizontal bar was used to represent the expected time for each task, with the left end marking the beginning of the task and the right end marking the expected completion date. The various tasks were run sequentially, in parallel or overlapping. The facilitator’s role was to ensure that process redesign was kept at the forefront of discussion, timelines were adhered to, and reporting functions directly followed. Suggestions for improvement were generated and presented to clinicians for discussion, with the aim of reaching consensus. Agreed recommendations formed the basis of the implementation. Subsequent regular feedback was provided to nephrologists.

Key findings, actions, and recommendations of each of the three PPIs are summarized below.

**Notification of the patient to the nephrology service (NWDS):** To efficiently plan not only the care of each individual patient but also the distribution of dialysis services, it is essential that the provider of the service has early warning of the patient’s need for dialysis. Specifically, Australian (CARI) and American (KDOQI) guidelines recommend that patients should be referred to a nephrology service when the eGFR has deteriorated to 30 mL/min and for vascular access when the GFR has deteriorated to 25 mL/min. As with many dialysis services, the NWDS had no automatic administrative or medical triggers to facilitate the notification. In particular, there was no requirement for the nephrologist to register a particular patient for dialysis, and often geographical considerations and the nature of private consulting practices appeared to discourage early referral.

Recognizing these barriers, it was concluded that the process should be one of registration rather than referral. An audit of data revealed that patients were commonly not known to the NWDS until eGFR’s were well below the CARI and KDOQI guidelines. Nephrologists were therefore encouraged to register all patients with an eGFR of ≤30 mL/min with the service. eGFR provides a more accurate measure of renal function than serum creatinine values. Its application is therefore important part of the registration process. This registration was logged electronically in a continually updated database, which then generated recommended actions, including suggestion of invitations to patient/carer education sessions, hepatitis B immunization, anaemia management [8], and access provision [8]. There was no mandatory requirement for the nephrologist to register the patient with the NWDS or, indeed, to follow the patient care pathway advice given. A by-product of this process was knowledge of the geographical distribution of patients with stage 3 and 4 chronic kidney disease.

**Pre-dialysis education:** The Managing Kidney Failure programme (MKF) was developed to provide timely education to patients with chronic kidney disease so that they could make informed decisions on their choice of treatment and participate in the management of their chronic kidney disease. It was decided that the MKF would consist of three sessions to be attended over 2–4 weeks.

In metropolitan areas, the pre-dialysis education programme consists of two education sessions, two review sessions, and one or more visits to dialysis training units. The introductory education session provides an overview of renal failure and treatment regimes. At the first review, recorded details are checked and individual questions answered. The second education session provides an insight into dialysis lifestyle and support, with the second medical review planning dialysis education and access. The decision on dialysis modality is made during the pre-dialysis education programme, after clinical assessment and consultation. Those patients commencing dialysis visit the dialysis training units to meet the training staff. To reduce travelling, most patients attend the introductory session and first interview on a single day, likewise, the lifestyle session and second review session are held on the same day, a fortnight later. NWDS staff visit regional centres to conduct individual programmes for patients who live outside the metropolitan area.

**Referral for vascular access:** No formal process existed to ensure adequate permanent access before commencement of haemodialysis. Conference with nephrologists resulted in agreed targets that patients should be referred for vascular access surgery when the eGFR was ≤25 mL/min, that 95% of patients electively commencing dialysis should have a permanent vascular access, and that this access should be established at least 6 weeks before commencement of dialysis. Nephrologists were regularly reminded of this eGFR target, with the database of patients requiring access insertion used to ensure availability of sufficient surgical operating time. A surgical coordinator was appointed to manage this process.

### Implementation and evaluation

The redesigned pathway for management of pre-dialysis chronic kidney disease is summarized in Figure 2. The specific objectives of this pathway redesign were to:

1. encourage earlier notification of each patient to the NWDS so that better planning for that patient could occur;
2. facilitate earlier establishment of vascular access;
3. increase the proportion of patients commencing haemodialysis with a permanent access.

The new protocols for patient registration and referral for vascular access were introduced in October 2000. The revised protocol for pre-dialysis education commenced in March 2002. In each case, baseline data were obtained for the time immediately before implementation.

Effectiveness of the process redesign was evaluated by comparing the relative performance in key areas before and after process implementation. Results of this evaluation were then used to further develop process improvements on an ongoing basis (Figure 1).
For the purpose of analysis, all data were divided into three monthly intervals. Statistical comparisons were made between the end of the observation period (January–March 2004) and the baseline period immediately before process redesign (July–September 2000). Categorical data were compared by chi-square analysis with the Mann–Whitney rank test used to compare numerical values. Linear regression analysis was used to plot trend lines.

Results

Between July 2000 and March 2004, 595 patients commenced maintenance dialysis with the NWDS. Of these, 137, 163, and 182 new patients started in calendar year 2001, 2002, and 2003, respectively, representing a 33% increase in patients commencing dialysis over the 3-year period. Currently, there are 649 pre-dialysis patients registered with the service with either stage 3 chronic kidney disease (CKD) \( (n = 409) \) or stage 4 and 5 CKD \( (n = 240) \) [6].

Notification of patients to NWDS

During the period of the review, the median eGFR at time of patient notification has ranged between 13 and 22 mL/min (Figure 3; \( P = \text{ns} \) January–March 2004 versus July–September 2000). Patients registered with an eGFR less than 10 mL/min decreased from 29 to 6% in the same period (Figure 4; \( P < 0.001 \)). Those patients not known to the service at commencement of dialysis decreased from 57% in July–September 2000 to 0% by January–March 2004 (Figure 5; \( P < 0.001 \)).

![Flow chart showing modified clinical pathway for pre-dialysis patients. Patients are registered with the North West Dialysis Service (NWDS) with automatic invitation to the Managing Kidney Failure programme (MKF) for education and referral to the surgical unit for vascular access.](image-url)

![Figure 3 Median patient calculated creatinine clearance (eGFR) at registration with North West Dialysis Service (NWDS). Horizontal broken line shows registration target of 30 mL/min. Vertical broken line shows implementation of patient registration protocol. Trend line \( (r = 0.28, P = \text{ns}) \) is indicated by the diagonal unbroken line.](image-url)

![Figure 4 Percentage of patients registered late with the North West Dialysis Service (NWDS), where late registration was defined as presentation with an eGFR less than 10 mL/min. Horizontal broken line shows late registration target of 0%. Vertical broken line shows implementation of patient registration protocol. Trend line \( (r = 0.72, P < 0.01) \) is indicated by the diagonal unbroken line \(* P < 0.001 \) versus July–September 2000.](image-url)
Pre-dialysis education
Before introducing the MKF, only 50% of patients starting dialysis had attended an education session. By the first quarter of 2004, this had increased to 74%.

Approximately 20% of our chronic kidney failure patients commenced peritoneal dialysis and were therefore not prepared for haemodialysis.

Vascular access
Eighty-three per cent of patients commenced dialysis with a permanent access in January–March 2004, compared with 24% in July–September 2000 (Figure 6; \( P < 0.001 \)). Most patients had an arteriovenous (AV) fistula. Less than 5% of patients required an artificial arteriovenous conduit.

Before the programme implementation, 50% of patients commenced dialysis within 1 month of an access insertion. From 2001 to 2002, the median interval between access and commencement of dialysis had increased to 2 months, with a further increase to 3 months by March 2004.

Institutionally, provision of real data regarding patients awaiting access insertions has also led to allocation of increased theatre time for access insertion.

Commencement of dialysis
Before the implementation of registration targets, 50% of patients presented to the NWDS less than 1 month before commencing dialysis. By January–March 2002, the median interval between registration and commencement of dialysis increased to 6 months, with a further increase to 14 months by January–March 2004 (Figure 7; \( P < 0.001 \) versus July–September 2000).

Discussion
Appropriate management of pre-dialysis patients with chronic kidney disease (stages 3–5) is essential for optimal patient outcomes. Recognizing deficiencies in the current arrangements, the NWDS undertook a redesign of referral practices and pathways. In this article, we describe the design and implementation of a system for timeliness of registration (R), provision of education (E), insertion of surgical access (A), and commencement on dialysis (D), which we internally
described by the acronym R-E-A-D. As a result of implementing R-E-A-D, we have seen improvements in the timeliness of notification of patients to the service, pre-dialysis education rates and an increase in provision of permanent access before commencement of dialysis.

We have not as yet had the opportunity to evaluate the extent of late referral of patients to nephrologists by general practitioners. Late referral of patients to the service has been a constant problem in the NWDS. Consistently associated with suboptimal end stage kidney disease care, late referral results in worse outcomes for patients [10–12] with a greater incidence of anaemia and hypoalbuminemia, lower prevalence of AV fistulas and grafts and a corresponding higher percentage of vascular catheters at initiation of dialysis [1]. Mortality of patients referred within 4 months of initiating dialysis has been shown to be nearly 70% greater than those referred earlier [1,13]. To provide an efficient and effective service to patients commencing dialysis, and to plan for new dialysis facilities [14], it is imperative that patients are registered with the dialysis service in a timely manner.

Any attempt to alter practice must take into account the clinical practice of the clinicians involved. The Diamant Alpin Collaborative Dialysis Study Group recently highlighted that the type of referring physician and structure of the dialysis unit are important contributing factors to late referral [15]. Given our large geographical diversity, this is probably even more relevant to the NWDS than many other dialysis providers. In our management pathway, we therefore concentrated on a system of notification and registration when renal function declined below agreed targets. The primary objective of setting targets was to ensure that the NWDS was notified of future patients. This has been particularly successful with 100% of chronic kidney disease patients commencing chronic dialysis now known previously to the service.

Our clinical care pathway is specifically designed to manage the care of patients by physicians not directly employed by the service. Registration with the service is an important step in utilizing primary care physicians and internists not employed by the service. This registration provides a mechanism for managing the transition of patients to dialysis from both internal and multiple external multiple primary physicians.

To provide an optimal introduction to dialysis treatment, it is preferable that patients have a working permanent vascular access at initiation of haemodialysis, typically either an AV fistula or synthetic graft. Permanent vascular access, that is AV fistula, is associated with greater longevity, lower infection, and intervention rates, and is predictive of lower mortality [16,17]. Within our institution, no formal process existed for the insertion of a permanent vascular access. Ad hoc pathways included referral from the patient’s nephrologist to a surgeon who would insert the access in either a private hospital or a public facility. In many instances, patients had an AV fistula and a temporary cuffed subclavian catheter inserted together so that the patient could commence dialysis while the AV fistula matured. In the period July–September 2000 less than 30% of patients commenced dialysis with a permanent access. We have seen a gradual improvement in this figure with more than 80% of patients now commencing maintenance dialysis with an established AV access. Improvements were seen from the time the review process commenced, not just from implementation of the redesign, possibly due to an inherent increased awareness of the problem as the redesign occurred. Furthermore, the collection of these data has meant that the Royal Melbourne Hospital has been willing to commit additional surgical theatre time to accommodate these procedures.

Caskey et al. [18] have suggested that, rather than early referral per se, it is the smooth transition onto dialysis that is associated with improved quality of life. Likewise, even after early referral to dialysis, there seems to be additional survival advantages associated with exposure to a multidisciplinary team [19,20]. Such studies highlight the importance of a coordinated approach to the management of the transition from chronic kidney disease to end stage renal disease and to renal replacement therapy. Consistent with this, we have integrated provision of permanent access, patient education, and centre planning into our model of patient registration.

In this article, we have specifically reported on our attempts to evaluate the implementation of our modified pre-dialysis programme. Our analysis does, however, have some limitations. We have not, for instance, been able to account for co-morbidities and patient demographics. Effectiveness of our programme may therefore have varied across patient groups. Furthermore, we have not been able to evaluate the cost effectiveness of this programme. Such analyses will need to be addressed in future studies.

In conclusion, through process redesign, we have formulated and implemented a programme (R-E-A-D) resulting in improved patient outcomes and efficiency of patient flow through the system. If evidence-based clinical practice guidelines are to accomplish the ultimate purpose of improving patient outcomes, then effective and efficient plans for implantation are required. Implementation remains the final and most difficult challenge [4] of all the rudiments of the guideline process. Our programme has highlighted the importance of stakeholder consensus on targets, tracking of patients through registration systems, audit and feedback, and integration of multidisciplinary teams in implementing clinical pathways. These generalizations are applicable to both national and international institutions.

References


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