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Establishing an evidenced-based dietetic model of care in Haemodialysis using implementation science

Running title: EBP haemodialysis dietetic service implementation

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Authorship Declaration

HM lead the project and collected data. HM and BM analysed data. KC and SW supervised the project. All authors contributed to interpretation of results, and revision of the manuscript.

All authors are in agreement with the manuscript and declare that the content has not been published elsewhere.

1

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Abstract

Aim: To establish an evidence-based dietetics service in an in-centre haemodialysis unit utilising Implementation Science.

Methods: The service was developed through the Knowledge-to-Action Framework. The steps of the Action Cycle were addressed through a literature review, identification of evidence-based guidelines, benchmarking, and local staff engagement. The theoretical domains framework (TDF) was used to identify barriers/enablers, and behaviour change wheel to determine appropriate interventions. To monitor, evaluate outcomes, and assess sustained knowledge use we employed multidisciplinary team engagement and database use. Audit data were collected at baseline, 6 and 12 months on nutrition assessment (Patient-Generated Subjective Global Assessment), intervention timeliness, and alignment to dietetic workforce recommendations. Descriptive statistics, McNemar tests, and a linear mixed model were applied.

Results: Barriers existed in the knowledge, skills, environmental context and resources TDF domains. Suitable interventions were identified with training on nutritional management of haemodialysis patients delivered to 148 nurses, and nutrition management recommendations summarised into local procedural resources. A database to prompt and monitor outcome measures was created and indicated that over 18 months post service commencement, eligible patients received nutrition assessment at least 6-monthly, aligning with recommendations. Prevalence of malnutrition was 28% (n=9/32) at baseline, 23% (n=5/22) at 6 months, and 20% (n=4/20) at 12 months (p= 0.50).

Conclusions: We demonstrated benefits to service development and implementation with implementation science providing a structured and methodical approach to translating guidelines into practice. Development of training, resources and prompts for outcome measures has supported the establishment of an evidence-based dietetics service in a haemodialysis unit.

Key words: Renal, clinical nutrition and dietetics, malnutrition, evidence based practice

1   **Introduction**

2   The increasing prevalence of Chronic Kidney Disease (CKD) is a global health problem

3   causing high burden on patients and the health care system. In Australia prevalence of

4   CKD is around 10% which equates to approximately 1.7 million Australian adults with

5   CKD.[1,2] Nutrition care is vital for all people with CKD, not only for assisting in management

6   of electrolyte disturbances, fluid balance, mineral and bone disorders, but also to prevent

7   and manage protein-energy wasting (PEW).[3] PEW is highly prevalent in haemodialysis

8   patients (up to 64%),[4] and is predictive of increased morbidity and mortality in CKD.[3,5]

9   Therefore, monitoring and management of PEW is essential in the haemodialysis

10   population.

11

12   Various national and international evidence-based guidelines are available to guide

13   nutrition management during haemodialysis.[3,6-11] Additionally, there are Australian

14   workforce recommendations[12] and state government demand-management protocols

15   known as "Frameworks for Effective and Efficient Dietetics Services" (FEEDS)[13] to guide

16   practice. Implementation of these evidence-based nutrition guidelines is associated with

17   improved nutrition status and reduced rates of malnutrition which is linked to mortality in

18   haemodialysis patients.[14,15]

19

20   Despite the existence of evidence-based nutrition guidelines, failure to routinely translate

21   evidence into clinical practice is a common finding in health services.[16] Awareness and

22   dissemination of guidelines alone does not always change practice and the assessment of

23   influencing factors (barriers and enablers) and implementation and evaluation design

24   should be systematic and theory-driven.[17,18] Barriers for implementing CKD evidence-

25   based guidelines have been identified in surveys with specialist renal dietitians in Australia

26   and New Zealand, with barriers being a perceived lack of time, skills/self-efficacy, and

27   inefficient referral systems relating to lower rates of guideline implementation.[19] Inadequate

28   staffing has been identified as a barrier in the provision of appropriate care with various

29   renal services having inadequate staffing allocations to meet recommendations.[12]

30

4

31   This paper describes the planning and implementation of a new nutrition service at an in-

32   centre haemodialysis unit established at a metropolitan tertiary hospital in Queensland. The

33   process undertaken to translate haemodialysis nutrition guidelines into practice in the

34   establishment of an evidence-based haemodialysis model of care used an Implementation

35   Science approach. Specifically, this project aimed to follow the Knowledge-to-Action (KTA)

36   cycle,[20] theoretical domains framework (TDF)[21] and behaviour change wheel (BCW)[22] to

37   apply evidence in a local setting following an assessment of barriers and enablers,

38   designing of effective interventions supported by routine monitoring, and evaluation

39   processes.

40

41   **Methods**

42   This project was commenced in September 2016 to meet the needs of a new in-centre

43   haemodialysis service, with a total of twelve dialysis chairs for both public and private

44   health funded patients, available for morning and evening shifts, opening November 2016.

45   To develop, implement, and evaluate our haemodialysis model of care we applied the KTA

46   which is an iterative approach that allows building (Knowledge Creation) and application of

47   knowledge (Action Cycle).[23] The steps of the Action Cycle can occur sequentially or

48   concurrently and involve identification of the problem, assessing knowledge use

49   determinants, evaluating the impact of knowledge use or outcomes, and ensuring

50   sustainability.[20] In this project assessment and intervention selection required use of the

51   integrative TDF[21] and BCW;[22] the TDF as a system for defining barriers, and the BCW as

52   a system for guiding decision-making around designing behaviour change interventions

53   based on the barriers.[22,24]

54

55   The action cycle process of problem identification involves reviewing and selecting

56   knowledge, then adapting knowledge to the local context. Therefore,

57   renal nutrition guidelines were identified by a literature search through Pubmed, CINAHL,

58   Scopus, Web of Science, Google Scholar with publications in the last five years, however

59   key guidelines were later included up to twelve years after publication.[3,6,7,9-11,25,26] We

60   systematically mapped our clinical service and collated the best available evidence for the

61   clinical area using Nutrition Care Process Terminology.[27] Service mapping and

62   comparisons included benchmarking with external haemodialysis centres regarding models

63   of care such as current inpatient and outpatient dietetic procedures, referral and monitoring

64   processes, and training programs. Engagement with management and staff internal

65   (Nephrologists, Nursing, Mater Education) and external (Fresenius – a service partner) was

66   undertaken to define the wider service plan, including expected capacity with patient

67   numbers, time frames for dialysis and possible service expansion plans.

68   Assessment of knowledge use determinants, specifically barriers to knowledge use, was

69   conducted through clinic observation, along with team discussion with key partners

70   including management, Nephrologists, and local dietitians, with information collection about

71   current practices, the service plan, and identification of potential barriers prior to

72   haemodialysis service commencement. Barriers were categorised and defined using the

73   TDF which includes the twelve domains; knowledge, skills, social/professional role and

74   identity, beliefs about capabilities, beliefs about consequences, motivation and goals,

75   memory and decision processes, environmental context and resources, social influences,

76   emotion, behaviour regulation, and nature of the behaviours. Application of the BCW was to

77   be used to determine intervention appropriateness for the barriers and enablers identified

78   with the TDF domains.[22]

79

80   In order to monitor knowledge use, evaluate outcomes, and sustain knowledge use a

81   database was created for dietitian use, and analysed six-monthly. Data was collected as an

82   audit to define the population and demonstrate effectiveness of the service change. Data

83   included outcome measures of malnutrition prevalence as assessed with the PG-SGA

84   category (categorised as A: well-nourished, B: moderately malnourished, or C: severely

85   malnourished), and numerical score (range 0 to 50, with lower score indicating reduced

86   malnutrition risk),[28] timeliness of intervention after commencing haemodialysis, and overall

87   dietitian time allocation and number of occasions of service as extracted from the Team

88   Allied Health Data Information System. The dietitian full-time equivalent (FTE) for the

89   haemodialysis unit was compared to those in workforce recommendations suggesting 1

90   FTE for every 100 haemodialysis patients.[12] The dietitian would also see patients

91   undergoing haemodialysis short-term or who were admitted on inpatient wards, however

92   these were not included in general data collection.

93

94   A database was developed for the dietitian to record patient demographics, PG-SGA

95   scores, consult dates and prompts for future reviews for patients attending the

96   haemodialysis service. There were automatic referrals for all new patients to the service,

97   and reviews were determined by the dietitian or requested from the multidisciplinary team.

98   All patients that attended the service during the 18 months following opening were

99   assessed including with a PG-SGA, with an aim to be completed within one month of

100   commencing haemodialysis and a minimum of six-monthly thereafter as usual care. Data

101   were audited and analysed six-monthly however data were excluded from analysis for

102   patients that were dialysing short-term, palliative, admitted to alternative tertiary hospitals,

103   or discharged from the service in less than six months.

104

105   Patient characteristics including age, gender, and public or private funding source, were

106   presented using descriptive statistics, with means and standard deviations used for

107   continuous variable, if normally distributed, and median and interquartile ranges otherwise.

108   Categorical variables were described using counts and percentages. For the outcome, PG-

109   SGA category (A: well-nourished, or, B and C: moderately and severely malnourished) as a

110   binary variable, we considered baseline and after 12 months with McNemar test used to

111   test for an association. As outcome PG-SGA score was both continuous and repeatedly

112   measured over time we used a linear mixed model to account for the correlated longitudinal

113   nature of data. All analysis was conducted using SPSS for Windows version 24. A

114   significance level of 0.05 was used throughout all inferential analysis.

7

115

116   This study received exemption from ethical approval from the hospital's Human Research

117   Ethics Committee (HREC/18/MHS/90).

118

119   **Results**

120   Assessment of barriers identified the main TDF domains to be knowledge, skills, and

121   environmental context and resources as detailed further in Table 1. Interventions were

122   developed to address barriers with appropriateness determined from use of the BCW.[24]

123   These interventions have been operationalised as various strategies shown in the final

124   column in Table 1.

125   Evidence-based guidelines for nutritional management of haemodialysis patients were

126   identified and summarised into a local document to assist the dietitian gain knowledge and

127   guide the nutrition care process and training content.[3, 6-11]

128

129   Training was a key intervention function to address knowledge and skills barriers for

130   nursing and dietetics. This was undertaken in ten identical face-to-face training workshops

131   conducted with a total of 148 nursing staff from both public and private hospital sectors as

132   haemodialysis patients would be both public and privately funded. The nutrition component

133   of the workshops involved a 25-minute presentation with session topics including the

134   various nutrition components for haemodialysis patients, the role of the dietitian and when

135   to refer patients to the dietitian. The nutrition component was developed alongside various

136   other components relevant to the care of patients with chronic kidney disease including the

137   patient journey, pharmacological considerations, nursing and fistula care. The workshop

138   was complimented by development of an online learning guide for nursing staff which is

139   being reviewed by a team of health professionals including doctors, clinical educators,

140   nursing staff, pharmacists, and the renal dietitian, for future education program use. This

141   learning guide included nutritional management of haemodialysis patients, pathways for

142   dietitian referrals, along with other aspects of nursing care for haemodialysis patients.

8

143

144   A one-off presentation was also prepared for professional development of all Nutrition and

145   Dietetic department dietitians. This presentation described the dialysis unit including

146   number of dialysis chairs, potential patient numbers, timing of dialysis, and the role of

147   nutrition in haemodialysis with NCP components expanded on from the nursing nutrition

148   module.

149

150   Service design included involvement in multi-disciplinary processes such as meetings,

151   monthly blood review (with Nephrologist, Pharmacist, Nursing), and education strategies for

152   both staff and patients. The dietitian was involved in mentoring and peer reviewing to

153   further ensure knowledge and skills barriers were addressed. The haemodialysis dietetic

154   service was also integrated into a Nutrition and Dietetic department strategy of regular

155   evaluation and reporting.

156

157   Figure 1 shows the patient flow during the 18-months of haemodialysis service. There was

158   a total n=33 eligible patients that attended the haemodialysis service over the eighteen

159   months following service commencement. Outcome measures were collected with n=32 at

160   baseline, and n=22 and n=20 at six and 12 months respectively. There were incomplete

161   malnutrition data for a total of two patients (n=1 at baseline, and n=1 at six-month follow-

162   up), and a total of n=27 were excluded over the period from November 2016 to May 2018,

163   with 63% (n=17/27) that left the service with continued dialysis at alternative sites. Patients

164   that did not meet eligibility were still seen by the dietitian as part of usual care however data

165   were not included in analysis.

166

167   The mean age of the haemodialysis population was 63.7 (SD=16.8) years and 52%

168   (n=17/33) of these patients were male. A majority of patients (93.9%, n=31/33) were public

169   patients. A total of 48.5% (n=16/33) of the patients included were new to dialysis;

170   commencing dialysis for the first time at the service. In the initial 18 months following

171   service establishment, 100% of patients received dietetics assessment as part of usual

172   care.

173

174   All haemodialysis patients were seen for nutrition assessment including a PG-SGA in the 6-

175   monthly time-points and a priority was placed on nutrition assessment of newly

176   commencing haemodialysis patients.

177

178   Initial assessment with use of PG-SGA was completed 24.0 (SD=23.4) days after

179   commencing at the dialysis unit, with repeat measures at 6.0 (SD=1.5) months, and 11.8

180   (SD=1.6) months. Included within the 12-month PG-SGA data were two outliers that

181   received assessment of PG-SGA at 9-months post- commencing at the service however

182   they were included as nutrition guidelines recommend minimum of six-monthly

183   assessment. Of patients new to dialysis, 88% (n=14/16) were seen within one month of

184   commencing dialysis.

185

186   Malnutrition prevalence is detailed in Table 2. There was no statistical change in

187   malnutrition categories or score over the 12 months (P=0.45), with the majority of patients

188   (72-80%) being well nourished from commencement and at all time-points. While a

189   decrease in PG-SGA score was seen in our sample, with an average PG-SGA score of 6.2

190   (95% CI: 4.6-7.8) at baseline, 5.3 (95% CI: 3.5-7.2) at six-months, and 4.8 (95% CI: 2.8-

191   6.7) at 12 months, this was not statistically significant (P=0.49).

192

193   The dietitian was allocated initially a 0.3 FTE to provide service for a total of 23 patient

194   (equivalent of 1.30 FTE to 100 haemodialysis patients) and this increased over the 18

195   months to 0.4 FTE for a total of 29 patients (equivalent of 1.38 FTE to 100 haemodialysis

196   patients), however the allocation also included the additional time provided for service

197   development and inpatient renal nutrition care. On average over the 18 month period

198   greater than 87% of dietitian time was face-to-face or patient-related activity. There was an

10

199 increased review frequency for patients that were malnourished, requiring weight

200 management for renal transplant eligibility, requiring nutrition education and counselling

201 due to nutrition-related abnormal biochemistry or fluid control.

202

203 **Discussion**

204 Following an IS approach we successfully developed, implemented and evaluated an

205 evidence-based haemodialysis dietetic service. This approach allowed for targeted nutrition

206 education and training interventions for staff, and clearly defined dietetic service processes

207 and procedures, with NCP components detailed and adapted for the local context. A

208 mechanism prompting routine monitoring of outcomes has also been adopted into usual

209 care, allowing for easier regular evaluation with continuation of the KTA cycle.

210 Subsequently, the development and implementation of the service has resulted in

211 haemodialysis patients receiving nutrition assessment within appropriate time-frames (a

212 minimum of 6-monthly) as recommended in evidence-based guidelines.[9] The service has

213 had sufficient dietetic staffing levels, with additional FTE provided above the workforce

214 recommendations allowing for service development and expected service growth. The

215 initial education and training with nursing is planned to be repeated and further review of

216 the online module to assist with sustaining knowledge and skills.

217

218 For patients attending the evidence-based haemodialysis dietetic service, the majority (72-

219 80%) have been well-nourished. The malnutrition prevalence in the current population was

220 low from commencement and through all included time-points. The reason for malnutrition

221 prevalence prior to attending the service can not be commented on however alternative

222 variables impacting malnutrition prevalence may be an area for further research. The

223 literature suggests malnutrition prevalence in the haemodialysis populations of up to 64%,[4]

224 however implementation of evidence-based practice in previous studies has shown

225 beneficial clinical outcomes on malnutrition prevalence.[15] Another study implementing

226 evidence-based practice in a haemodialysis population showed a decrease in malnutrition

11

227 prevalence from 14% at baseline to 3% in three years.[15] This study had similar

228 demographics, however had a higher ratio of private facility patients, and excluded patients

229 that had been undergoing dialysis for less than three months where the current study

230 included patients new to haemodialysis. The PG-SGA data assists in explaining the

231 population, aligns with similar research and as many renal services routinely monitor

232 malnutrition prevalence six-monthly, the data may assist for comparison and

233 benchmarking.

234

235 Although initial outcome measures were aiming to achieve the minimum of 6-monthly

236 assessment, there was further collaboration and attendance at monthly blood reviews and

237 multi-disciplinary meetings to ensure avenues for communication, close monitoring of

238 biochemistry, and prompting for more regular reviews if indicated. This open

239 communication is seen as an enabler for the referral process which has otherwise been

240 suggested as a potential barrier in previous research.[19] Furthermore, support from

241 management and higher dietetic FTE than the 1:100 haemodialysis patients recommended

242 in workforce guidelines assisted in the ability to use the IS approach and was an enabler to

243 perceived time barriers that have been identified by other renal dietitians for nutrition

244 guideline implementation.

245 However, during the initial 6-month period there were two occasions of nutrition

246 assessment of new dialysis patients being prolonged further than the one month suggested

247 by Fouque et al [8]. This was identified and created further understanding of processes and

248 the potential barrier of reduced workforce over public holidays and the need to ensure

249 appropriate predictions for these times.

250

251 The current dietetics service aligns with the Framework for Effective and Efficient Dietetic

252 Services (FEEDS) recommending patients be seen a minimum of 6-monthly with use of a

253 nutrition assessment tool such as SGA or PG-SGA.[13] The FEEDS document also prioritises

254 referral reasons, recommends experienced dietitians or mentoring, and similarly provides

12

255   references for evidence-based guidelines, all of which were incorporated into local work

256   area resources. However, this study provides further detail on implementation of evidence-

257   based guidelines into dietetic practice with the use of frameworks as an example to allow

258   for an iterative process for others.

259

260   The strength of this study is the systematic application of frameworks such as the KTA,

261   TDF and the BCW in planning the implementation of the new model of care. Use of theory

262   and frameworks has been shown to be more effective than projects based on intuition.[29,30]

263   Further strengths include the structured approach to implementation of evidence-based

264   guidelines in service development, which allows for future research, wider collaboration,

265   and assistance in streamlining services. This IS approach may provide an example for

266   other similar dietetic services establishing or implementing an evidenced-based model of

267   care. Limitations include the small sample size which impacts the ability to detect

268   statistically significant changes in measured outcomes. However, these will continue to be

269   routinely evaluated to obtain an ongoing measure of our service effectiveness and will allow

270   planning of data-informed, iterative service changes, as required. Further limitations relate

271   to the lack of access to the evaluation of knowledge transfer to nursing staff after training,

272   patient satisfaction and consumer engagement during the service development. However,

273   this has been acknowledged and will be completed in future training and education, and

274   service provision has also included a structured plan for patient satisfaction and consumer

275   engagement.

276

277   As part of our department's wider commitment to delivering evidence-based care through

278   continual application of the KTA cycle we plan to monitor the services identified outcomes

279   6-monthly and develop our service and incorporate new evidence into our practice as

280   literature becomes available, as required. Furthermore, it is acknowledged that guidelines

281   are only as robust as the research that informs them and call for ongoing Knowledge

13

282   Creation activities to enhance the delivery of evidence-based nutrition care in

283   haemodialysis.

284

285   **Conclusion**

286   We have demonstrated the benefits to service development and implementation that can

287   results from the use of IS frameworks and models (KTA, TDF, BCW) to translate evidence-

288   based guidelines into practice. These tools have enabled a structured and methodical

289   approach to both establishment and continued implementation of the service over time. Key

290   interventions including training, local resource development, and a working database

291   embedding monitoring and evaluation of outcome measures into practice has resulted in

292   maintenance of nutrition status over the 18 months following service commencement.

293   There is a plan to continue these processes with ongoing monitoring and evaluation and

294   use of these frameworks and implementation science as the service grows. Further

295   research needs to be conducted in evaluation of training programs, consumer feedback,

296   and alternative variables impacting malnutrition prevalence.

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Table 1. Overview of the application of the Knowledge to Action (KTA) framework, linked with identified barriers/enables for the proposed

haemodialysis service, paired with interventions and strategies to operationalise interventions

Knowledge-to-Action cycle[20]	Identified barriers (TDF domain)[21]	Enablers	Intervention function (from BCW)[22]	Intervention function operationalised as strategies[24]
Identify problem/identity, review, select knowledge	No previous service therefore assumed limited knowledge of nutrition management during dialysis for dietetics and nursing staff (Knowledge)	Goals with guidelines to specify details of nutrition care process and workforce and external sites to model or benchmark	Psychological capability	1. Comparison with alternate dialysis sites dietetic service (modelling) 2. Literature review informing procedures and outcome measures from identified evidence-based nutrition guidelines 3. Knowledge and skills-based training with nursing staff and dietetics
Assess barriers to knowledge use	No existing haemodialysis service Time barrier for dietetics (environmental context and resources)	Defined nutrition care 'goals' or outcome measures from literature Recommendations around dietetic staffing as per literature[12] Management support in providing recommended staffing	Psychological capability Physical opportunity	1. Development of local documents detailing NCP components for nutrition and haemodialysis and incorporating into development of local processes/procedures 2. Creation of dietetic database with outcome measures and prompts for review and service provision 3. Determining FTE and dietetic allocation provided
Select, tailor, implement interventions	No previous service therefore assumed limited knowledge for dietetics and nursing staff (Knowledge, skills, beliefs about capabilities)	Interest in learning and engagement from management and Mater Education	Psychological capability Physical opportunity	1. Training packages for nursing staff and dietitians 2. Mentoring with identified experienced renal dietitians 3. Personal upskilling
Adapt knowledge to local context	No previous experience in knowledge to action process for the renal dietitian (Cognitive Skills)	Commencement of new service so no previous local context or beliefs	Psychological capability	1. Professional development and personal upskilling 2. Peer reviewing 3. Mentoring
Monitor knowledge use	No local dietetic processes in place (environmental context and resources)	Defined nutrition care process and goals from literature	Physical capability	1. Monitoring of outcome measures 2. Reporting outcome measure to key stakeholders
Evaluate outcomes Sustain knowledge	No haemodialysis dietetic model of care in place	Dietetic department with focus in evidence-base practice and regular	Physical opportunity	1. Creation of database with outcome measures and prompts for review and

| use | (Environmental context and resources) | monitoring and evaluation processes in place and encouraged | | service provision
2. Involvement in MDT processes such as meetings, monthly blood review (with Nephrologist, Pharmacist, nursing), education strategies (nursing, patient, and dietetics)
3. Integration of haemodialysis dietetic service into department reporting and strategy planning |

Table 2. Malnutrition prevalence of haemodialysis patients at baseline, 6-months, and 12-months following commencement at the service

	Baseline	six-month	12-month	P-value
Total patients (N)	32	22	20	
PG-SGA Category (N)				0.45[1]
- A (Well nourished)	23 (71.9%)	17 (77.3%)	16 (80.0%)	
- B (Moderately malnourished)	8 (25.0%)	4 (22.7%)	4 (20.0%)	
- C (Severely malnourished)	1 (3.1%)	0		
PG-SGA Score	6.2[2] (95%CI: 4.6-7.8)	5.3 (95%CI: 4.6-7.8)	4.8 (95%CI: 2.8-6.7)	0.49[3]

[1] McNemar test based on two categories (PG-SGA A: well-nourished, PG-SGA B and C: moderately and severely malnourished) with baseline and 12 months follow-up

[2] Missing score for n=3

[3] Linear Mixed Model