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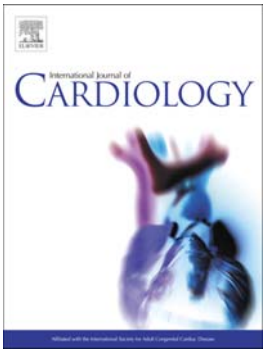

Improving medication titration in heart failure by embedding a structured medication titration plan

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PII: S0167-5273(16)32069-1
DOI: doi: 10.1016/j.ijcard.2016.09.001
Reference: IJCA 23608

To appear in: *International Journal of Cardiology*

Received date: 5 May 2016
Revised date: 19 August 2016
Accepted date: 1 September 2016

Please cite this article as: Hickey Annabel, Suna Jessica, Marquart Louise, Denaro Charles, Javorsky George, Munns Andrew, Mudge Alison, Atherton John J., Improving medication titration in heart failure by embedding a structured medication titration plan, *International Journal of Cardiology* (2016), doi: 10.1016/j.ijcard.2016.09.001

TITLE PAGE

Improving medication titration in heart failure by embedding a structured medication titration plan

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Acknowledgements of grant support

This work was supported by Queensland Health's, The Brisbane North Partnership Council as part of their Connecting Healthcare in Communities initiative.

Acknowledgements: Jamil Ahmed, Andrew Case, Kerry Driver, Carlos Fernandez, Jayne Ingham, Katie Kerr, Suzanne Lee, Sophie Lloyd, Maria Podger, Kathleen Powter, Linda Prentice, Serena Rofail

Competing interests: John Atherton has received consultancy fees and honoraria from Menarini and Servier.

Key words: Medication, Titration, Heart failure, HFrEF, Beta-blocker, ACE inhibitor

ABSTRACT

Background: To improve up-titration of medications to target dose in heart failure patients by improving communication from hospital to primary care.

Methods: This quality improvement project was undertaken within three heart failure disease management (HFDM) services in Queensland, Australia. A structured medication plan was collaboratively designed and implemented in an iterative manner, using methods including awareness raising and education, audit and feedback, integration into existing work practice, and incentive payments. Evaluation was undertaken using sequential audits, and included process measures (use of the titration plan, assignment of responsibility) and outcome measures (proportion of patients achieving target dose) in HFDM service patients with reduced left ventricular ejection fraction.

Results: Comparison of the three patient cohorts (pre-intervention cohort A n=96, intervention cohort B n=95, intervention cohort C n=89) showed increase use of the titration plan, a shift to greater primary care responsibility for titration, and an increase in the proportion of patients achieving target doses of angiotensin converting enzyme inhibitors/angiotensin receptor blockers (ACEI/ARB) (A 37% vs B 48% vs C 55%, p=0.051) and beta-blockers (A 38% vs B 33% vs C 51%, p=0.045). Combining all three cohorts, patients not on target doses when discharged from hospital were more likely to achieve target doses of ACEI/ARB (p<0.0001) and beta blockers (p<0.0001) within six months if they received a medication titration plan.

Conclusions: A medication titration plan was successfully implemented in three HFDM services and improved transitional communication and achievement of target doses of evidence-based therapies within six months of hospital discharge.

INTRODUCTION

Heart failure (HF) is a major public health problem associated with significant morbidity and mortality.(1) Large randomized controlled trials have demonstrated that angiotensin converting enzyme inhibitors or angiotensin receptor blockers (ACEI/ARB) and beta blockers decrease hospitalization and prolong survival in patients with HF with reduced left ventricular ejection fraction (HFrEF). However, these therapies can be difficult to manage in real-world clinical practice as HF patients frequently transition between acute hospital and primary healthcare sectors, and are often older and more complex than patients enrolled in the randomized controlled studies.(2) Nonetheless, suboptimal treatment is responsible for a substantial proportion of avoidable re-hospitalizations and deaths.(3)

Whilst several studies have reported that only a small proportion of HFrEF patients are on target doses of ACEI/ARB and beta blockers at the time of hospital discharge,(3, 4) this may not be a true reflection of the final doses achieved, given that these drugs may require careful up-titration over several months.(5) However, a single-center audit of post-discharge titration of heart failure medications in our health service had previously identified that only 13% of patients achieved target doses at three months (unpublished data). This is similar to other reports of 17 to 43 % of patients achieving target doses within three to six months of hospital discharge.(6-9) This “titration gap” is partly explained by higher rates of drug intolerance in unselected, older patients with multiple comorbidities who are under-represented in clinical trials,(5) but may also represent an opportunity to improve adherence to evidence-based treatment in HF.

Barriers to guideline adherence include context-specific factors impacting upon provider knowledge, attitudes and behaviors, such as lack of awareness, lack of familiarity,

lack of self-efficacy, inertia, patient expectations, and inadequate time or resources.(10-12) Interventions to improve prescribing behaviors have mostly focused on provider knowledge and attitudes. Although interventions such as education, point-of-care decision support and profiling with feedback have been associated with systematic improvements in some time series studies,(9) other studies of this approach have been disappointing.(13)

In the context of transition from hospital-based to primary care, communication of current therapy and expected treatment plans appears to be a major barrier and large registry studies confirm that discharge communication for HF patients is poor.(9) Heart failure disease management (HFDM) programs improve outcomes in patients recently discharged from hospital, helping to provide a "bridge" between hospital and primary care.(14) Specialized HF medical clinics or protocol-driven nurse and pharmacist led clinics can be effective in improving titration following hospitalization (15-18) although this finding has not been universal.(6) HFDM services may help to address barriers by providing access to specialized multidisciplinary staff familiar with current guidelines, who have the time and skills to support medication monitoring. However access to these services remains limited(19) and the general practitioner (GP) usually remains the key provider. Clear communication between the HFDM service, specialty services and GPs may help to improve GP familiarity and confidence with prescribing, as well as set consistent patient and provider expectations.

We undertook a quality improvement project to enhance discharge communication between the hospital and primary care in order to improve the titration of ACEI/ARB and beta blockers following discharge from hospital with a primary diagnosis of HFrEF. Our primary goal was to embed an individualized HF medication titration plan (using a

standardized form) into clinical practice. The medication titration form included the discharge and recommended target dose of ACEI/ARB and beta blockers, the order of titration, and the primary clinician responsible for managing titration. We hypothesized that improved communication between healthcare providers would result in a higher proportion of HFrEF patients achieving target doses of medications by six months following hospital discharge. We report our findings using the SQUIRE guidelines for quality improvement research.

METHODS

Setting

Metro North Hospital and Health Service (MNHHS) is the largest publicly funded health service in Australia servicing approximately 900,000 people in South East Queensland. We undertook the study in three hospitals that have established HFDM teams and together care for 80% of HF hospitalizations within MNHHS. Two of the hospitals are large teaching hospitals (one with an advanced HF transplant service) and the third is a district hospital servicing a rapidly growing population on the urban fringe of Brisbane. The HFDM services include expert HF nurses, clinical pharmacists and physiotherapists, and specialist medical supervision of the programs. The services provide active case finding throughout the hospital with an opt-out approach; patient and carer education continuing post hospitalization; discharge coordination between the inpatient treating team, the GP and primary care services; and multidisciplinary clinic and/or telephone-based follow-up. About 20 % of patients attend a structured weekly group education and exercise program. None of the services offer home visits. Medical follow-up may include HF, general cardiology or medical outpatient clinics depending on local resources and patient preferences.

The study conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the Human Research Ethics Committee (HREC) for all three hospitals which reviewed the study protocol and deemed it exempt from ethical review.

Planning the intervention

The project was supported by a steering committee and three clinical working groups. The steering committee consisted of two cardiologists, a general physician, two GPs, a pharmacist, a community HF nurse practitioner, and two community-based general nurses. The committee met quarterly to provide strategic advice and planning. The implementation group consisted of a senior project manager, clinical working groups of nurses, pharmacists and medical leads associated with HFDM services at each participating hospital, and representatives of information technology services in the hospital and primary care, who met as required to refine and implement intervention strategies.

Interventions were introduced and refined in a quality improvement Plan, Do, Study, Act (PDSA) cycle. The interventions centered on supporting the use of a HF medication titration plan and methods to embed the titration plan into standard clinical practice including performance feedback to HFDM services, ensuring timely communication of the titration plan to the GP following discharge from hospital, investigating electronic methods of transferring discharge information, considering the use of case-conferencing, and providing incentive payments.

Medication titration plan

Prior to the study, a workgroup including nursing, pharmacy, cardiology and general medical representatives had developed and piloted an individualized written HF medication

titration plan using a standardized form. Modifications were made following input from renal and respiratory medical specialists (see HF Medication Titration Plan, figure 1). This document detailed ACEI/ARB and beta blocker therapy on discharge with clear instructions regarding the order and extent of titration of these medications. Instructions for weight-based diuretic titration were provided if appropriate. The document allowed clear delegation of the primary person responsible for titration (hospital specialist, HFDM nurse, or GP) and provided a troubleshooting guide. The primary person was negotiated by the heart failure disease management staff in discussion with the patient and in collaboration with the treating hospital team and general practitioner, influenced by practical and clinical considerations including clinical complexity, physical access to services, patient preference, and provider confidence. Patients had the option to choose to see their general practitioner to supervise medication titration. In these cases, the general practitioner was contacted by the heart failure nurse to confirm that they were happy to supervise titration. The medication titration plan addressed several potential barriers by providing individualized point-of-care decision support; setting clear expectations which could be developed in collaboration with the patient; providing access to a specialist service if time or skills were a barrier to titration; and providing single point accountability. Although the medication titration plan was available, it was inconsistently used prior to the project.

This improvement project aimed to embed the use of the HF medication titration plan into routine clinical practice with the goal of improving medication titration for patients with HF in the community. Specifically, it aimed to improve post-discharge communication of a titration plan, provide clearer accountability for titration, and thereby increase achievement of optimal dosing of ACEI/ARB and beta blockers by six months after hospital discharge.

Implementation of titration plan

Barriers and potential solutions were developed by interviewing GP's and practice managers of patients attending HF services in MNHHS as well as consulting with hospital-based implementation groups. These are summarized in Table 1 along with the actions agreed to by the project steering committee.

Planning the evaluation

Design and patient characteristics

To evaluate the effect of the intervention, we conducted three audits of consecutive, eligible patients with HFrEF discharged from the study hospitals between July to December 2009 (Cohort A, pre-intervention), 2010 (Cohort B) and 2011 (Cohort C). Recruitment of patients for all groups was at the same time of year to minimize the influence of seasonal variation. The baseline audit (Cohort A) was retrospective and the two intervention groups (Cohorts B and C) were prospective.

Eligibility criteria were patients newly referred to the hospital-based HFDM services following an admission to hospital with a primary diagnosis of HFrEF, with a left ventricular ejection fraction (LVEF) <50%, who were then followed up in the MNHHS and had no documented contraindication to medication titration or palliative intent to treatment. Given that the aim of this study was to evaluate titration of medical therapy over six-months, patients were excluded if they could not be contacted or died during the follow-up period.

Measures and outcomes

Patient characteristics, prescription and doses of HF medications at hospital discharge and six months, and quality of medication titration information communicated was collected

from hospital charts, HFDM service notes, electronic discharge summaries, and electronic databases, supplemented if necessary by telephone interviews of patients, their GPs or GP practice managers. Data were collected by an experienced project manager not involved in delivery of services.

The primary endpoint was the proportion of patients who were on target doses of either ACEI/ARB or beta blockers at six months following discharge from hospital. Target doses were those defined in the major clinical trials that demonstrated the mortality and morbidity benefit for these treatments and reported in therapeutic guidelines.(20) A secondary endpoint limited the analysis to those patients who were not receiving target doses of either ACEI/ARB or beta blockers at the time of hospital discharge. Additional, pre-specified endpoints were the proportion of patients who received a HF medication titration plan, and the proportion of patients where there was clear identification of the primary clinician responsible for medication titration. An additional exploratory analysis combined all three cohorts to identify whether completion of a titration plan was associated with greater achievement of target dose.

Analysis

The proportion of participants achieving each of the pre-specified outcomes was compared between the three groups using Chi-squared tests, or Fisher's exact tests when the expected cell counts were low. In the exploratory analysis of all cohorts combined, we sought associations between the use of the titration plan and target dose achievement at six months, as well as exploring other potential factors influencing successful titration, using chi-square testing.(21) We undertook multivariable logistic regression and adjusted for age, hospital and

cohort to identify any variables that may be predictors of target dose achievement. Statistical significance was considered as $p<0.05$ in all analyses.

RESULTS

Improvement interventions

Initial planning commenced in 2009, and the program was launched in 2010. Results from the retrospective audit of usual care (Cohort A) were summarized and fed back to the clinical workgroups and to GPs. One-hour interactive workshops were delivered to each of the HFDM teams to refresh knowledge about the medication titration content, clarify that they would take primary responsibility for completion, and discussing their role in negotiating with the patient/carer, hospital staff and GP about continuing titration responsibilities. Information about the medication titration plan was sent to GPs through their network newsletter, which included contact details for the project leader. Further feedback though local networks was provided in 2011 following the second audit, and included contact details for key staff within the HFDM services for GPs to be able to contact if required.

Attempts at using electronic transmission had limited success. We designed a macro that could be embedded within the electronic discharge summary; however this was only used eight times (seven times for Cohort B, once in Cohort C). The main barrier to the use of the macro was the coordination required between the HFDM nurses and junior medical staff in finalizing the electronic discharge summary. Secure, web-based emailing was technically complex making it difficult for hospitals to use and GP's to access. The health record exchange (a record initiated by primary care with the permission of the patient) was rarely accessed by clinicians as most patients were not registered, and there were delays in software

installation. Therefore, completion of the medication titration plan as a stand-alone document with fax following hospital discharge was the primary mode of transmission utilized between the HFDM services and the GP.

While substantial planning was undertaken to facilitate use of the Medicare chronic disease billing process, coordination of the eligibility requirements and hospital and GP staff was too challenging in practice within existing resources, and was abandoned in the first six months as there had been no uptake. In 2011, the steering committee members on the statewide cardiac clinical network successfully advocated for state government quality incentive payments to support implementation of the titration plan. This provided a direct payment of $150 to all HFDM services in Queensland (including the three HFDM services involved in this study) for each titration plan completed, for use on clinical services and/or education.

Study sample

The flow of patient recruitment for each study group is shown in Table 2. Of the 335 patients who met eligibility criteria, 9.9 % died and 6.6 % were lost to follow-up at six months post-hospital discharge. The final analysis included the 280 patients who survived and had six-month follow-up data on medication titration status. Of this cohort, 98% were eligible to take ACEI/ARB and 96% were eligible for beta blockers. Six-month follow-up data were missing in a greater proportion of patients in the retrospective cohort (Cohort A).

The patient characteristics for the three study cohorts are described in Table 3. Groups were similar for age, sex, hospital length of stay, LVEF and number of comorbidities (which included any chronic medical condition such as peripheral neuropathy, diabetes,

hypertension, ischemic heart disease, gastro-esophageal reflux disease, gout, and depression). The number of medications prescribed and the use of Webster packs (weekly pharmacy packed blister packs) were similar for all three cohorts. There were similar rates of prescription, which were high with over 95% of patients prescribed an ACEI/ARB and over 90% of patients prescribed a beta blocker at the time of hospital discharge.

Impact of interventions on processes and outcomes

The proportion of participants who had a titration plan completed at hospital discharge increased throughout the study (Cohort A 26%, Cohort B 45%, Cohort C 61%, $p<0.001$). There was also a significant change ($p<0.001$) in the pattern of clinicians identified as responsible for titration in the plan (Figure 2), with an increase in those for whom the GP was responsible (Cohort A 27%, Cohort B 35%, Cohort C 49%) and a decrease in those for whom the specialist was responsible (Cohort A 18%, Cohort B 24%, Cohort C 2.8%) or no responsible clinician was identified.

At six months post hospital discharge, the proportions of eligible patients receiving an ACEI/ARB for Cohorts A, B and C respectively were 87/94 (93%), 90/94 (96%), and 81/85 (95%). Beta blocker prescription rates were 89/93 (96%), 89/90 (99%), and 82/84 (98%). The proportion of all eligible patients who achieved target doses six months after discharge for ACEI/ARB (37% vs. 48% vs. 55%, $p=0.051$) and beta blockers (38% vs. 33% vs. 51%, $P=0.045$) increased throughout the study period (see Table 4). Whilst this was partly accounted for by better achievement of target doses at hospital discharge throughout the study period (ACEI/ARB: 26/94 (28.0%); 29/94 (30.9%); 34/85 (40.0%) and beta blockers: 14/93 (15.1%); 11/90 (12.3%); 19/84 (22.6%)), the improvements in achieving target dose were still seen if the analysis was restricted to those patients who were not on target doses at the time of hospital discharge (Table 4).

Combining participants from all three cohorts, those who received a medication titration plan were more likely to achieve target doses of ACEI/ARB (54% vs 34%, p=0.001) and beta blockers (54% vs 38%, p=0.013). Restricting the analysis to patients who were not on target doses at the time of hospital discharge, those who received a medication titration plan were much more likely to achieve target doses of ACEI/ARB (49% vs 21%, p<0.0001) and beta blockers (46% vs 20%, p<0.0001).

To identify factors associated with not taking target doses of medication, we undertook an analysis combining patients in all three cohorts. Patients who were not taking target doses of ACEI/ARB at the completion of the study were older (71.6±14.6 vs. 66.5±13.9 yrs, P=0.004) and were less likely to have received a medication titration plan (33.6% vs. 54.3%, P=0.029). Patients who were not taking target doses of beta blockers were older (71.7±13.7 vs. 65.8±14.6 yrs, P=0.001), had a lower discharge weight (75.8±20.6 vs. 83.3±21.3 kg, P=0.011), had more comorbidities (5 (IQR 3-6) vs. 4 (IQR 2-6), P=0.022), and were less likely to have received a medication titration plan (38.4% vs. 53.7%, P=0.013). Logistic regression models were corrected for age, hospital and cohort. Older age (P=0.01) and not receiving a medication titration plan (P=0.015) were independent predictors for not taking target doses of ACEI/ARB, and older age (P=0.013) was an independent predictor for not taking target doses of beta blockers.

DISCUSSION

We undertook a quality improvement project in the setting of three established HFDM services to improve communication between hospital-based and primary healthcare

providers, in order to enhance the titration of medical therapy in patients following discharge from hospital with a primary diagnosis of HFrEF. The main quality improvement tool was a HF medication titration plan completed by HFDM staff that provided individualized point-of-care decision support and explicitly assigned responsibility for post-hospital medication titration. Implementation was facilitated by awareness raising through audit and feedback, targeted HFDM staff training, incorporation into existing work flows, and in the final cohort, financial incentives. Increased uptake of the medication titration plan was demonstrated in serial audits, and was associated with significant improvements in achieving target doses of evidence-based therapies at six months post-hospital discharge. A combined cohort analysis demonstrated that the use of the titration plan was associated with a higher proportion of patients achieving target doses.

Despite promising developments in information technology solutions to improve communication, technical and work flow complexity made these solutions impracticable. The limited utility of electronic processes to improve quality measures has been identified by others, with system and recipient issues that may impede successful implementation.(22) We therefore reverted to a faxed paper record to allow timely communication of the medication titration plan to the GP following hospital discharge.

Financial incentives had variable impact. Few GPs took advantage of the Medicare case conferencing reimbursement which was most likely related to the complexity in meeting Medicare billing requirements as previously described by others.(23) However, financial incentives provided to HFDM staff for facilitating medication titration form completion may have contributed to the continued improvement in uptake and outcomes in Cohort C compared to Cohort B.

Relation to other evidence

The proportion of patients achieving target doses in this study (55% for ACEI/ARB and 51% for beta blockers) approach those reported in the clinical trials that demonstrated the efficacy of ACEI, ARB and beta blocker therapy conducted in highly selected populations. These trials used forced up-titration, with at least 50-60% of patients achieving pre-specified target doses.(24-30) This is encouraging considering the additional support provided in clinical trial settings, compared to real world practice.

The demographics of the study sample are similar to patients with HFrEF seen by specialized HFDM teams elsewhere in regards to age, sex, and LVEF.(7, 16) While support for medication titration within HFDM services may improve target dose achievement,(15, 16) specialized services can better support patients by forming partnerships with primary care providers.(11, 31-33) Our findings complement the results of the Comparative study On guideline Adherence and patient Compliance in Heart failure patients (COACH-2) study, which demonstrated that patients could be discharged back to their GP following medication titration performed in a specialized HF service.(34) They observed similar guideline-recommended prescription of HF medications at 12 months for patients who were followed up by either their GP or in a dedicated HF clinic.(34) Our study suggests that GPs could also play a greater role in initial medication titration following discharge from hospital as demonstrated by the 20% increase in GPs nominated to manage titration by the end of the study, despite this group not directly benefiting from the financial incentives implemented. Audit and feedback as provided in this study has been shown to be effective in prescribing practice,(32) but is difficult to sustain without information systems that collect and report these data routinely. Furthermore, audit and feedback alone is unlikely to allow primary care

clinicians to follow complicated titration protocols. However, a dedicated medication titration plan with trouble-shooting guidelines facilitated by HFDM services was successful in our study. The application of incentive payments may have contributed to desirable behavior change, however these should be applied selectively to ensure that improvements in practice gaps are not accompanied by unanticipated harm. (35, 36)

Application in practice

Our findings are relevant to other facilities with HFDM services that have a role in facilitating communication at the transition of care from the hospital setting to the community. Unfortunately, such services are still not widely implemented in Australia.(19) Further investigation would be required to determine if the HF medication titration plan could be implemented in hospitals lacking such services, as part of their discharge planning. Education and training for multiple staff is likely to be a significant barrier in this context, and additional support methods such as audit and feedback, incentives and integration into work flows need to be carefully considered.

Limitations

Our study has a number of limitations. Firstly, in the absence of a randomized controlled study design, we cannot necessarily attribute the improvement in medication titration to the increased utilization of the medication titration plan or the specific strategies used. However, we initially evaluated the feasibility of introducing a number of quality improvement measures some of which were not successful. This required an adaptive study design, which would not have been possible in a randomized controlled study. Whilst the retrospective audit in the usual care group (Cohort A) enabled rapid collection of baseline data to help inform the development of interventions, it is also probably the reason that a

greater number of patients were lost to follow-up at six months. This may have introduced bias, although participant characteristics in the three cohorts were similar. This would also not explain the greater utilization of medication titration plans and higher titration rates achieved in Cohort C compared to Cohort B.

The contribution of the different interventions to enhance use of the medication titration plan remains uncertain, as with many successful behavior change interventions, and highlights the need for flexible, context-sensitive implementation. Electronic methods of transferring discharge information (secure, web-based emailing; health record exchange) were not successful and therefore not implemented, with the fax remaining the primary mode of transmitting the medication titration plan to the GP. Finally, this was a relatively small study and all three hospitals involved in our study had HFDM programs. Our findings may not apply to a more diverse heart failure cohort, or if these services are not available.

Conclusion

Using a combination of implementation strategies to embed a collaboratively developed, structured, HF medication titration plan, we significantly increased use of a shared titration plan with clear allocation of responsibility for titration. This was associated with a higher proportion of HFrEF patients achieving optimal doses of evidence-based HF medications over a three year period. Our findings support interventions that aim to achieve a seamless approach to HF care by enhancing collaboration between healthcare providers to facilitate transition from the acute hospital setting to the community. The introduction of incentive payments was associated with greater uptake of the titration plan, however further study is required to determine whether these benefits were maintained.

Figure legend

Figure 1: Heart Failure Medication Titration Plan

Figure 2: Changes in documented responsible clinician for titration

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Table 1: Barriers to titration plan use and proposed solutions

Barrier	Proposed solution	Proposed action
Unclear guidelines for use of titration plan	Steering committee articulated clear requirement for all discharged HF patients to have a medication titration plan communicated to GP within 2 weeks of discharge, regardless of principal place of follow-up	• Clinical working groups provide education and training to all HFDM staff • Clinical leads provide information to inpatient teams • Implementation team distribute newsletter to primary care for awareness raising
Confusion between health teams about responsibility for medication titration	Titration plan must state which health professional is expected to be the primary manager of titration post hospital discharge	Train HFDM staff to ensure specification of medication titration manager on titration plan
Changing junior medical staff with high training requirement	Primary responsibility for completing plan remains with HFDM staff who are consistent, interfacing with junior medical staff as required	Clinical working groups provide education and training to all HFDM staff on tool completion and methods of transmission of information
Competing tasks and priorities in HFDM service	Provide feedback on performance and incentives	• Implementation team provide annual audit and feedback • Quality incentive payment from state government of $150 paid to HFDM

		service (Cohort C only)
Poor interface with existing primary care IT systems	Integrate with existing hospital electronic discharge summary (EDS) and investigate novel methods of transmission	• IT services develop and implement "macro" to insert into EDS • IT services ensure titration plan compatibility with developing primary care health record exchange methods • HFDM staff trained in use of novel systems
GPs have difficulty identifying HFDM service staff	Clear identification of HFDM service staff	Contact details for HFDM service staff included in annual newsletter and in weekly updates to primary care and included on titration plan
Competing tasks and priorities in primary care	Reward for collaborating on plan development	Establish processes consistent with Medicare case conference for reimbursement (Government funded item for team plan with GP and two other health professionals)

Table 2: Patient flow

	Cohort A	**Cohort B**	**Cohort C**	**Total sample**
Patients referred	126	103	106	335
Died by 6 months	12	7	14	33
Lost to follow up by 6 months	18	1	3	22
Included in analysis	**96**	**95**	**89**	**280**
a) ACEI/ARB eligible	94	94	85	273
b) Beta blocker eligible	93	90	84	267

Table 3: Characteristics of subjects included in analysis

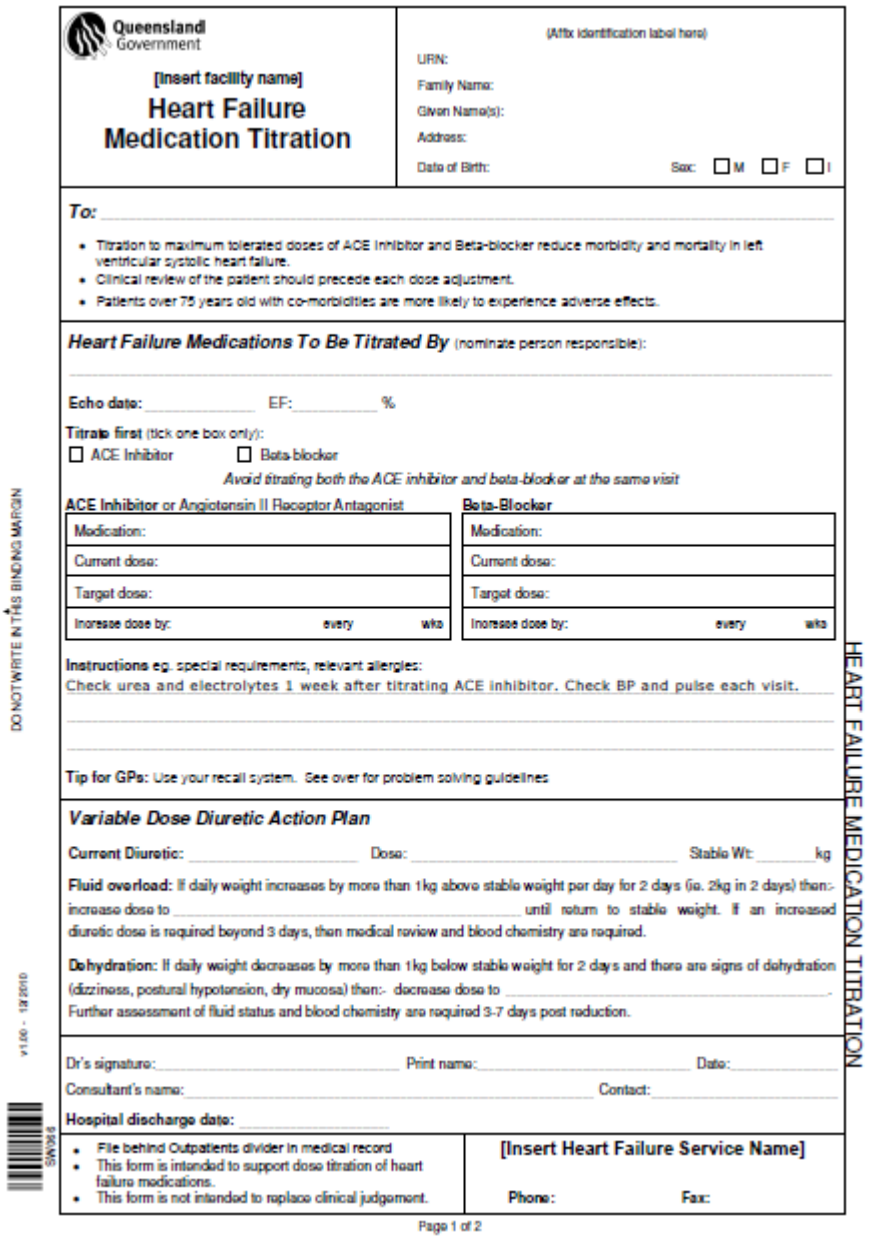
Characteristic	*Cohort A (n=96)*	*Cohort B (n=95)*	*Cohort C (n=89)*
Age, mean (SD)	68.4 (15.6)	70.4 (13.4)	69.7 (14.4)
Male	63.5%	63.2%	66.3%
Length of stay, median (IQR)	7 (4-12)	6 (4-9)	6 (4-10)
Ejection Fraction, mean (SD)	30.9 (8.3)	32.5 (10.1)	30.7 (9.8)
Number of medications at D/C, mean (SD)	10.7 (4.1)	9.7 (4.7)	10.7 (4.4)
Co-morbidities, median (IQR)	5 (3-6)	4 (3-6)	5 (3-6)
Diabetes	35.4%	27.4%	28.1%
Hypertension	47.9%	50.5%	55.1%
Webster Pack	11.5%	16.8%	16.9%
ACEI/ARB prescribed at discharge	96.9%	99.0%	95.5%
Beta blocker prescribed at discharge	94.5%	91.6%	94.4%

Table 4: Target dose achievement of ACEI/ARB and beta blockers at 6 months after discharge

Sample	Medication	Cohort A	Cohort B	Cohort C	p-value
All eligible patients	ACEI/ARB	35/94 (37%)	45/94 (48%)	47/85 (55%)	0.051
	Beta-blocker	35/93 (38%)	30/90 (33%)	43/84 (51%)	0.045*
Not on target dose on discharge	ACEI/ARB	16/68 (24%)	23/65 (35%)	21/51 (41%)	0.11
	Beta-blocker	23/79 (29%)	20/79 (25%)	29/65 (45%)	0.036*

*Significant at $p<0.05$

Fig. 1



Queensland Government

[Insert facility name]

Heart Failure Medication Titration

(Affix identification label here)

URN:

Family Name:

Given Name(s):

Address:

Date of Birth: Sex: ☐ M ☐ F ☐ I

To: _____

- Titration to maximum tolerated doses of ACE Inhibitor and Beta-blocker reduce morbidity and mortality in left ventricular systolic heart failure.
- Clinical review of the patient should precede each dose adjustment.
- Patients over 75 years old with co-morbidities are more likely to experience adverse effects.

Heart Failure Medications To Be Titrated By (nominate person responsible):

_____

Echo date: _____ EF: _____ %

Titrate first (tick one box only):

☐ ACE Inhibitor ☐ Beta-blocker

Avoid titrating both the ACE inhibitor and beta-blocker at the same visit

ACE Inhibitor or Angiotensin II Receptor Antagonist			**Beta-Blocker**		
Medication:			Medication:		
Current dose:			Current dose:		
Target dose:			Target dose:		
Increase dose by:	every	wks	Increase dose by:	every	wks

Instructions eg. special requirements, relevant allergies:

Check urea and electrolytes 1 week after titrating ACE inhibitor. Check BP and pulse each visit.

Tip for GPs: Use your recall system. See over for problem solving guidelines

Variable Dose Diuretic Action Plan

Current Diuretic: _____ Dose: _____ Stable Wt: _____ kg

Fluid overload: If daily weight increases by more than 1kg above stable weight per day for 2 days (ie. 2kg in 2 days) then:- increase dose to _____ until return to stable weight. If an increased diuretic dose is required beyond 3 days, then medical review and blood chemistry are required.

Dehydration: If daily weight decreases by more than 1kg below stable weight for 2 days and there are signs of dehydration (dizziness, postural hypotension, dry mucosa) then:- decrease dose to _____. Further assessment of fluid status and blood chemistry are required 3-7 days post reduction.

Dr's signature: _____ Print name: _____ Date: _____

Consultant's name: _____ Contact: _____

Hospital discharge date: _____

- File behind Outpatients divider in medical record
- This form is intended to support dose titration of heart failure medications.
- This form is not intended to replace clinical judgement.

[Insert Heart Failure Service Name]

Phone: **Fax:**

Page 1 of 2

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HEART FAILURE MEDICATION TITRATION

v1.00 - 18/2010

SW368

Queensland Government

[Insert facility name]

Heart Failure Medication Titration

(Affix identification label here)

URN:

Family Name:

Given Name(s):

Address:

Date of Birth: Sex: ☐ M ☐ F ☐ I

Heart Failure Medication Problem Solving Guidelines

NSAIDs or COX-2 inhibitors are contraindicated in patients with heart failure

Avoid negatively inotropic calcium-channel blockers (verapamil, diltiazem) in systolic heart failure

Asymptomatic low blood pressure

- Does not usually require any change in therapy (systolic BP 90 - 100 mmHg).

Symptomatic hypotension

- Refer patients with severe symptomatic hypotension or in shock to an emergency department immediately.
- If a low blood pressure is associated with dizziness, light-headedness and/or confusion, stop or reduce calcium-channel blockers and/or other vasodilators unless absolutely essential e.g. for angina.
- Consider reducing diuretic dose if no signs or symptoms of congestion.
- If these measures do not work, consider reducing ACE inhibitor or Beta-blocker dose *temporarily*.
- Review patient as clinically appropriate (daily – weekly). If these measures do not work, seek specialist advice.

Problem solving when using ACE inhibitors in heart failure

- Although rare, angioedema can occur at any time when using ACE inhibitors. Stop immediately and seek specialist advice. Trial of an Angiotensin II antagonist should only occur on specialist advice (possible cross-sensitivity).

Cough

- Cough is common in patients with heart failure. This may be due to pulmonary oedema, which should be excluded if cough is new or worsening.
- If the patient develops a drug cough that is likely to be caused by the ACE inhibitor, it is not always necessary to discontinue the drug. However if the cough is troublesome and/or interferes with sleep, consider substituting an angiotensin II receptor antagonist.

Worsening renal function

- ACE inhibitors are generally well tolerated even in patients with significant renal impairment (creatinine over 200 micromol/L or eGFR less than 30mL/min). However, these patients are more vulnerable. A destabilising event such as a dehydrating illness (sepsis, diarrhoea/vomiting), dehydration from overdiuresis or addition of nephrotoxic medications frequently precipitates acute renal failure leading to hospital admission.
- Patients should be advised to seek urgent medical attention in these situations, and to withhold the ACE inhibitor temporarily until reviewed and blood chemistry checked.
- Some rise in urea, creatinine and potassium is expected after commencing an ACE inhibitor due to a decrease in eGFR. If the change is small and asymptomatic, no action is necessary, but blood chemistry must be checked several days after initiation of therapy and monitored closely thereafter to ensure kidney function is not worsening.
- An eGFR decrease of up to 30% is acceptable provided it stabilises within 2 weeks.
- If the eGFR declines by more than 30%, the patient should be reviewed urgently for clinical assessment of volume status and review of nephrotoxic medications. Seek specialist advice regarding the safety of continuing therapy.
- Careful potassium monitoring is required. With an increase to 5.0 – 5.5, review and reduce potassium supplements/retaining agents (eg. amiloride, spironolactone, eplerenone). If 5.6 – 5.9, cease all potassium supplements/ retaining agents. If greater than 6, seek immediate specialist advice.

Problem solving when using Beta-blockers in heart failure

Worsening symptoms/signs (eg. increasing dyspnoea, fatigue, oedema, weight gain)

- If congestion develops, increase the diuretic dose.
- If increasing the diuretic dose does not work, halve dose of beta-blocker and liaise with the heart failure service.
- If marked fatigue and/or bradycardia (see below), halve dose of beta-blocker (rarely necessary).
- Review patient as clinically appropriate (daily – weekly). Seek specialist advice if not improved.
- If serious deterioration, refer patient to an emergency department immediately.

Low heart rate

- If < 50 beats/min and worsening symptoms, halve dose of beta-blocker (rarely necessary).
- Review the need for other drugs that slow heart rate (e.g. digoxin, amiodarone) in consultation with specialist.
- Arrange ECG to exclude heart block.
- Review patient as clinically appropriate (daily – weekly). Seek specialist advice.
- If severe deterioration, stop beta-blocker and refer patient to an emergency department immediately.

Endorsed by Queensland Heart Failure Steering Committee October 2009

[Insert Heart Failure Service Name]

Phone: Fax:

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Fig. 2