ORIGINAL RESEARCH ARTICLE

The Effect of Cardiovascular Credentialed Pharmacists on Process Measures and Outcomes in Myocardial Infarction and Heart Failure

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Objective The purpose of this study was to determine if institutions with inpatient cardiovascular credentialed pharmacists exhibit improved quality measures for acute myocardial infarction (AMI) and heart failure (HF) care compared with institutions without inpatient cardiovascular credentialed pharmacists.

Methods We conducted a multicenter, retrospective, cross-sectional, matched case-control study. Hospitals with at least one Added Qualification in Cardiology (AQCV) inpatient pharmacist were included in the case group. Each case group hospital was matched to hospitals without an AQCV pharmacist by region, number of cardiovascular discharges, and teaching hospital designation in a 1:3 ratio (case:control). The 34 AQCV hospitals were matched to 102 non-AQCV hospitals. The proportions of discharges meeting HF and AMI process of care measures and 30-day outcomes (readmission and mortality) for each hospital were determined from public data and compared between the case and control groups.

Results Hospitals with AQCV pharmacists performed better on process of care measures than hospitals without AQCV pharmacists (odds ratio 1.41, 95% confidence interval 1.25–1.58, $p<0.0001$, $p<0.001$ for heterogeneity), which was mainly driven by the aspirin on discharge for AMI and angiotensin-converting enzyme inhibitor or angiotensin receptor blocker on discharge for HF measures. No differences were observed between the groups for either readmission or mortality at 30 days.

Conclusions Hospitals that used inpatient AQCV pharmacists performed better on process of care measures than hospitals that do not use inpatient AQCV pharmacists. However, improvements in process of care performance measures observed in AQCV hospitals did not translate into improved 30-day clinical outcomes.

Key Words acute myocardial infarction, congestive heart failure, epidemiology, performance measures, pharmacist management, credentialing.

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Specialization with associated certification is a process endorsed by many health care professions with the primary purpose being improved patient care outcomes.[1, 2] Many national pharmacy organizations, including the American College of Clinical Pharmacy (ACCP), American Association of Colleges of Pharmacy (AACP), American Pharmacists Association (APhA), and the American Society of Health-System Pharmacists (ASHP), currently endorse pharmacist specialization credentialing to meet the vision for the future of pharmacy practice.[3–7] The ACCP emphasizes the need to expand recognition of

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specialized pharmacists' knowledge and skill. In addition, the ACCP appreciates that this recognition will become even more important as practice expectations grow, as more practicing pharmacists provide direct patient care, and as the profession transitions from a "product-centered" to a "patient-centered" model.[4]

Current pharmacist credentialing is optional for pharmacists and is done primarily through the Board of Pharmacy Specialties (BPS). The BPS was organized in 1976 as an independent certification agency of APhA and has the responsibility to ensure the public receives the level of pharmacy services that will improve a patient's quality of life.[2] The BPS currently offers six specialty areas of board certification: nuclear pharmacy (BCNP), pharmacotherapy (BCPS), nutrition support pharmacy (BCNSP), psychiatric pharmacy (BCPP), oncology pharmacy (BCOP), and, most recently, ambulatory care pharmacy (BCACP). The BPS also established the designation "Added Qualifications" in 1997 to recognize and denote an individual with an "enhanced level of training and experience within one segment of a BPS-recognized specialty that targets specific diseases or patient populations."[2] To date, added qualifications in cardiology (AQCV) and infectious diseases (AQID) within the pharmacotherapy specialty have been approved and require the applicant to be BCPS certified before applying for added qualifications.

The certification of AQCV is conducted through an application and portfolio process reviewed annually by a review committee.[2] The portfolio is similar to a curriculum vitae and consists of all experiences related to the focus area of cardiology but may not include experiences associated with training, such as a residency or fellowship. The committee assesses whether five areas related to cardiovascular pharmacotherapy have been achieved: (i) the pharmacist's ability to provide pharmaceutical care to patients with cardiovascular diseases; (ii) analysis and interpretation of scientific literature related to cardiology and clinical care (that is, involvement on the Pharmacy and Therapeutics Committee or review articles written for other health care professionals); (iii) conducting research or being a peer-reviewer for a journal; (iv) education of health care professionals, students, and patients; and (v) other involvement in the area of cardiology, including membership in a cardiovascular organization or an award or recognition for excellence in cardiovascular pharmacotherapy, education, or research. An examination is not taken for AQCV certification. Recertification occurs every 7 years after the submission of an updated portfolio.

Although pharmacy credentialing is strongly advocated by those in the pharmacy profession, there is little to no evidence suggesting that board certification, including the AQCV distinction, improves patient outcomes and justifies the expenses incurred. Improved patient care is assumed, as credentialed pharmacists are required to undergo an assessment of their therapeutic knowledge and contributions to the profession of pharmacy, as well as maintain a high level of knowledge through advanced continuing education. These assumptions have not, at this time, been evaluated to see if any differences in process of care and 30-day measures of quality exist between credentialed and noncredentialed pharmacists. The purpose of this study is to determine if institutions with inpatient AQCV-credentialed pharmacists exhibit improved quality measures for acute myocardial infarction (AMI) and heart failure (HF) compared with institutions without inpatient AQCV-credentialed pharmacists.

Methods

Design

This is a multicenter, retrospective, cross-sectional, matched case-control study. A list of BCPS AQCV pharmacists (n=80) was derived from publicly available data on the BPS website in July 2011 for inclusion in the study. AQCV pharmacists were excluded if they do not provide direct patient care to acute care hospital inpatients, if they work outside of the United States, or if they work at a Veterans Affairs hospital. Veterans Affairs hospitals were excluded because data were not available from the Hospital Compare website (www.hospitalcompare.hhs.gov) at the time the data were collected. From the 41 pharmacists meeting inclusion and exclusion criteria, 34 hospitals in total were represented, forming the AQCV group (five hospitals had two AQCV pharmacists and one hospital had three AQCV pharmacists). Matching each case group AQCV hospital to a hospital without an AQCV pharmacist in a 1:3 manner assembled the control group and was performed a priori. Control hospitals were matched by geographical region, number of cardiovascular discharges, and Council of Teaching

Hospitals and Health Systems (COTH)-defined teaching hospital. Geographic region was primarily within the same state and secondarily within the same U.S. Census–defined region. The number of cardiovascular discharges was derived using the Hospital Compare website and was the denominator for the readmission and death outcomes. All data and calculations were based on Medicare data on patients discharged between September 2007 and June 2010 and collected between September 2011 and February 2012. The University of Michigan Health System institutional review board approved the study protocol.

Outcome Measures

The proportions of discharges meeting AMI and HF process of care measures, 30-day readmission rate, and 30-day mortality for each hospital were determined from the Hospital Compare website. Process of care measures determined to be medication related for AMI were aspirin on arrival, aspirin at discharge, β-blocker at discharge, and angiotensin-converting enzyme (ACE) inhibitor or angiotensin II receptor blocker (ARB) at discharge in patients with left ventricular systolic dysfunction. The performance measure for statins at discharge was not a reportable measure at the time of data collection. The process of care measure determined to be medication related for HF was ACE inhibitor or ARB on discharge. Currently, HF is defined by a left ventricular ejection fraction of less than 40% for these measures.

Statistical Analysis

The main outcomes were a composite of the process of care measures and combined 30-day event rates. For the process of care measures, the outcome represents the composite of the five medication-related process measures for both AMI and HF. Likewise, 30-day event rates for both mortality and readmission were combined for both AMI and HF. The Cochran–Mantel–Haenszel (CMH) test was used to evaluate each main outcome comparing the AQCV hospitals with non-AQCV hospitals stratified by matching (1:3). This method allowed us to match on important components inherent to each AQCV hospital. The Breslow–Day test was used to test for homogeneity among the odds ratios (ORs) for each stratum. Each individual component of the main outcomes was also analyzed in the same method. Logistic regression was used to control for any difference found in baseline hospital characteristics. Categorical variables are presented as frequencies and percentages. All statistical analyses were performed using SAS software version 9.3 (SAS Institute Inc., Cary, NC).

Results

The 34 AQCV hospitals were matched to 102 non-AQCV hospitals. Baseline data from each hospital are represented in Table 1. The average number of AMI and HF discharges combined approached 2000 annually in both groups with no significant differences observed. Hospitals in both groups were well matched based on geographical location. After matching based on COTH, significantly more teaching hospitals existed in the AQCV group compared with the non-AQCV group (p=0.001).

Process of Care Measures

Hospitals that used inpatient AQCV pharmacists performed better on the composite of medication-related process of care measures compared with hospitals that do not use inpatient AQCV pharmacists (OR 1.41, 95% confidence interval [CI] 1.25–1.58, p<0.0001, p<0.001 for heterogeneity). Based on the individual process of care measures, significantly more discharges are prescribed mortality-lowering

Table 1. Baseline Characteristics of Hospitals with AQCV-Credentialed Inpatient Cardiology Pharmacists Compared with Hospitals Without AQCV-Credentialed Inpatient Cardiology Pharmacists

	AQCV (n=34)	Non-AQCV (n=102)	p-Value
Average number of cardiovascular discharges annually[a]			
AMI	787 ± 474	725 ± 611	0.58
HF	1261 ± 769	1151 ± 753	0.46
Geographic location, n (%)			
Northeast	5 (14.7)	14 (13.7)	0.99
Midwest	10 (29.4)	30 (29.4)	
South	14 (41.2)	43 (42.2)	
West	5 (14.7)	15 (14.7)	
COTH-defined teaching hospital, n (%)	29 (85.3)	55 (53.9)	0.001

AQCV = Added Qualification in Cardiology; AMI = acute myocardial infarction, COTH = Council of Teaching Hospitals and Health Systems, HF = heart failure.

[a]Cardiovascular discharges were derived from the Centers for Medicare & Medicaid Services data.

medications at the time of discharge in hospitals that use AQCV pharmacists compared with hospitals that do not: aspirin on discharge for AMI (OR 1.38, 95% CI 1.05–1.82, p=0.019, p<0.0001 for heterogeneity, n=46,843) and ACE inhibitor or ARB on discharge for HF (OR 1.7, 95% CI 1.41–2.05, p<0.0001, p<0.0001 for heterogeneity, n=22,942). Aspirin on arrival (OR 1.12, 95% CI 0.82–1.54, p=0.47, p<0.0001 for heterogeneity, n=33,721), β-blocker on discharge (OR 1.24, 95% CI 0.98–1.58, p=0.068, p<0.0001 for heterogeneity, n=44,921), and ACE inhibitor or ARB at discharge for AMI patients with left ventricular systolic dysfunction (OR 1.36, 95% CI 0.92–2.01, p=0.11, p<0.0001 for heterogeneity, n=8060) were not statistically different. When adjusting for the baseline difference of COTH, the results were consistent (Figure 1). See Data Supplement Table S1 for individual matched ORs and statistics.

Thirty-Day Cardiovascular Events

Thirty-day readmission for AMI and HF was no different in hospitals that used inpatient AQCV pharmacists compared with those that do not (AMI OR 0.99, 95% CI 0.94–1.04, p=0.59, p=0.0002 for heterogeneity, n=54,452; HF OR 1.02, 95% CI 0.97–1.06, p=0.38, p<0.0001 for heterogeneity, n=65,093). Likewise, 30-day mortality after either AMI or HF did not differ among those hospitals with inpatient AQCV pharmacists compared to those without (AMI OR 0.98, 95% CI 0.92–1.04, p=0.57, p=0.87 for heterogeneity, n=46,018; HF OR 0.98, 95% CI 0.92–1.03, p=0.41, p=0.4 for heterogeneity, n=65,535). There was significant heterogeneity among the matched groups for all 30-day cardiovascular events. When adjusting for the baseline difference of COTH, the results were consistent (Figure 1). See Data Supplement Table S2–S5 for individual matched ORs and statistics.

Discussion

This is the first study, to our knowledge, to demonstrate that inpatient AQCV pharmacists may improve the performance of process of care quality measures compared with those not credentialed with AQCV. The main performance measures affected were prescription of aspirin at time of discharge for AMI and prescription of either an ACE inhibitor or an ARB at discharge for HF. Hospitals that use inpatient AQCV pharmacists did not, however, have superior 30-day event rates for either AMI or HF. Readmission and mortality at 30 days for both HF and AMI in this Medicare population were similar

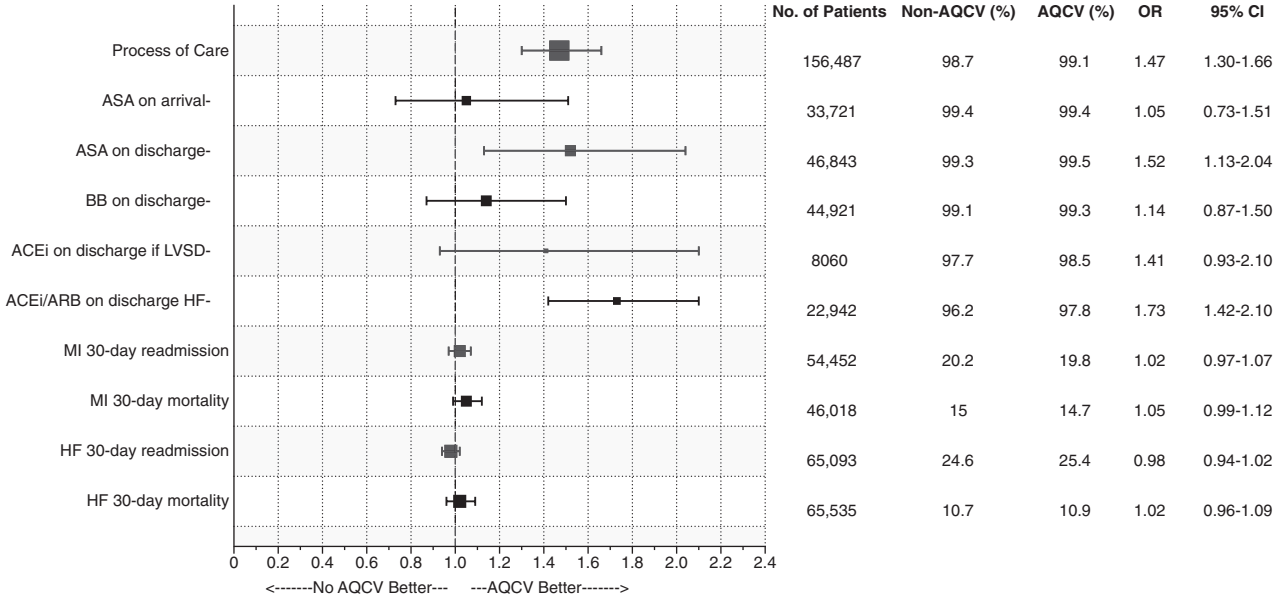

Figure 1. Process of care measures and 30-day outcomes for AMI and HF adjusted by the Council of Teaching Hospitals and Health Systems. For myocardial infarction process of care measures, the number of patients for each process of care measure differs due to differences in eligibility and/or exclusion criteria for each measure. Odds ratios are inverted for 30-day outcomes to maintain consistency with the *y*-axis legend. ACEi = angiotensin-converting enzyme inhibitor, ARB = angiotensin receptor blocker, BB = β-blocker, CI = confidence interval, HF = heart failure, LVSD = left ventricular systolic dysfunction, MI = myocardial infarction, OR = odds ratio.

between hospitals using AQCV pharmacists and those with non-AQCV cardiovascular pharmacists.

Pharmacists improving medication-related process of care performance measures should come as no surprise. It has been well documented that pharmacist care increases the likelihood that patients will be prescribed evidence-based therapies resulting in improved clinical outcomes.[8–10] The differences in process of care outcomes observed in this analysis are conceivable. Inpatient AQCV pharmacists primarily intervene on patients after arrival to the hospital and are more likely to be involved with the discharge process related to medications (e.g., medication reconciliation, patient education). One would then expect that inpatient AQCV pharmacists would not affect the use of aspirin on arrival to the hospital (e.g., in the emergency department), but the utilization of medications at the time of discharge would be affected. Several inpatient clinical pharmacy services have been associated with improvements in health and/or economic outcomes, prompting a group[11] to suggest that the provision of drug information, admission medication histories, adverse drug reaction programs, collaborative drug management, and participation on medical rounds serve as a "core" set of clinical pharmacy services. It is possible that improvements observed in process of care measures are secondary to AQCV pharmacists being more effective in performing these and other clinical services compared with noncredentialed cardiovascular pharmacists; this hypothesis deserves more study.

The fact that we observed improvements in process measures without an improvement in clinical outcomes at 30 days is also not surprising. Several prospective randomized studies have associated HF process measure performance with improved clinical outcomes.[12] However, registry data have demonstrated that inpatient HF performance measures are not linked to short-term mortality.[13] Likewise, an analysis of AMI process measure performance accounted for only 6% of the variation in 30-day risk-adjusted mortality.[14] Therefore, our observations that improved process measure performance in AQCV hospitals did not translate into lower 30-day event rates were disappointing but not unexpected, particularly when one considers the multifaceted process surrounding transitions from hospital to home.

The relationship between specialty certification and clinical outcomes in other health professions is not clear. In fact, process measure performance and clinical outcomes associated with physician specialty certification mirror our observations related to pharmacist credentialing described earlier. Board-certified cardiologists performed better than board-certified family practitioners and board-certified internists with regard to AMI process of care measures (e.g., aspirin and β-blocker use), but these differences did not translate into lower 30-day mortality.[15] In contrast, clinical outcomes related to medical procedures may be better when performed by physicians with specialty certification. For example, periprocedural complications are lower and more eligible patients received cardiac resynchronization therapy when the implantation of cardioverter-defibrillators was performed by certified electrophysiologists compared with the implantation by other specialists.[16]

There are inherent limitations in an observational study design, in that we cannot exclude unmeasured confounding, selection bias, and information bias that may have occurred during the study. One limitation of the generalizability of these results is the significant heterogeneity between the matched strata. This demonstrates a significant difference in the performance patterns seen and the potential effect of inpatient AQCV pharmacists on these outcomes. Selection of the hospitals included in the analysis could have included bias. We attempted to limit the selection bias by matching hospitals on location and number of cardiovascular discharges. Our methods prevented us from quantifying the time AQCV pharmacists participated in patient care, which may be a limitation. For example, some AQCV pharmacists may be faculty members who do not practice year-round. It is possible, if not likely, that the quantity of time spent by non-AQCV pharmacists varies as well. Thus, the effect in the AQCV group is that of the AQCV pharmacist, regardless of the quantity of time spent providing direct patient care. Another limitation is that patient-level data were not available. We attempted to limit this by matching the hospitals on several parameters that we thought could confound the results. Also, significant heterogeneity existed in the process of care analyses. This raises some concern that the effect of AQCV pharmacists may not be consistent. This inconsistency may be due to the AQCV group or to the fact that the non-AQCV group had a more variable effect because of other credentialing or years of experience they embody. More research needs to be performed to determine if there is a

"dose" effect of pharmacist services, specific services that AQCV pharmacists provide, or other credentialing (BCPS alone) that is most beneficial when applied to process or outcome measures in AMI and HF.

Conclusion

Hospitals that used inpatient AQCV pharmacists provided higher quality of care for patients with AMI or HF compared with hospitals without inpatient AQCV pharmacists. However, similar to physician credentialing, improvements in process of care performance measures observed in AQCV hospitals did not translate into improved 30-day clinical outcomes in this Medicare population.

References

1. **American Board of Medical Specialties.** Available from http://www.abms.org. Accessed July 27, 2011.
2. **Board of Pharmacy Specialties.** Available from www.bpswebb.org. Accessed July 27, 2011.
3. **American College of Clinical Pharmacy.** ACCP position statement: board certification of pharmacist specialists. Pharmacotherapy 2011;31:1146–9.
4. **Blair MM, Freitag RT, Keller DL, et al.** Proposed revision to the existing specialty and specialist certification framework for pharmacy practitioners. Pharmacotherapy 2009;29:3e–13e.
5. **Spinler SA, Bosso J, Hak L, et al.** Report of the taskforce concerning board certification requirements for pharmacy practice faculty. Am J Pharm Educ 1997;61:213–6.
6. **Pradel FG, Palumbo FB, Flowers L, Mullins CD, Haines ST, Roffman DS.** White paper: value of specialty certification in pharmacy. J Am Pharm Assoc 2004;44:612–20.
7. **American Society of Health-System Pharmacists Web site.** Available from http://www.ashp.org. Accessed June 20, 2012.
8. **White C, Chow M.** Cost impact and clinical benefits of focused rounding in the cardiovascular intensive care unit. Hosp Pharm 1998;33:419–23.
9. **Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL.** Clinical pharmacists and inpatient medical care: a systematic review. Arch Intern Med 2006;166:955–64.
10. **Koshman SL, Charrois TL, Simpson SH, McAlister FA, Tsuyuki RT.** Pharmacist care of patients with heart failure: a systematic review of randomized trials. Arch Intern Med 2008;168:687–94.
11. **Bond CA, Raehl CL, Patry R.** Evidence-based core clinical pharmacy services in United States hospitals in 2020: services and staffing. Pharmacotherapy 2004;24:427–40.
12. **Maeda JL.** Evidence-based heart failure performance measures and clinical outcomes: a systematic review. J Card Fail 2010;16:411–8.
13. **Fonarow GC, Abraham WT, Albert NM, et al.** Association between performance measures and clinical outcomes for patients hospitalized with heart failure. JAMA 2007;297:61–70.
14. **Bradley EH, Herrin J, Elbel B, et al.** Hospital quality for acute myocardial infarction: correlation among process measures and relationship with short-term mortality. JAMA 2006;296:72–8.
15. **Chen J, Rathore SS, Wang Y, Radford MJ, Krumholz HM.** Physician board certification and the care and outcomes of elderly patients with acute myocardial infarction. J Gen Intern Med 2006;21:238–44.
16. **Curtis JP, Luebbert JJ, Wang Y, et al.** Association of physician certification and outcomes among patients receiving an implantable cardioverter-defibrillator. JAMA 2009;301:1661–70.

Supporting Information

The following supporting information is available in the online version of this paper:

Table S1. Unadjusted process of care measures for each matched cohort.

Table S2. Unadjusted 30-day mortality after myocardial infarction for each matched cohort.

Table S3. Unadjusted 30-day mortality after heart failure for each matched cohort.

Table S4. Unadjusted 30-day readmission after myocardial infarction for each matched cohort.

Table S5. Unadjusted 30-day readmission after heart failure for each matched cohort.