Circulation: Heart Failure

ORIGINAL ARTICLE

Impact of the Swedish Care Coordination Act on Heart Failure Readmissions and Length of Stay

Robert S. Kristiansson, MD; Douglas Spangler, PhD; Wilhelm Linder, MSc; Ulrika Winblad, PhD

BACKGROUND: Patients with heart failure tend to experience higher rates of hospital readmissions compared with other ambulatory care–sensitive conditions. In Sweden, the nationwide Care Coordination Act (CCA) was introduced in January 2018 with the goal of improving care coordination, resulting in a reduction of readmissions and length of stay. There is insufficient knowledge regarding the effect of this reform on patients with heart failure.

METHODS: We studied the association of implementing CCA on all-cause 30-day readmissions and length of stay for patients over 65 years of age with *International Classification of Diseases* code I50 (Heart Failure). The data set included all admissions with a primary diagnosis of heart failure among elderly, multimorbid patients between 2015 and 2019. An interrupted time series analysis using hierarchical mixed models with random effects clustered at the hospital ward level was conducted.

RESULTS: A total of 111 414 admissions were included. The average readmission rate for patients with heart failure was 26.8% before and 26.7% after the CCA. The average length of stay was 8.4 days before the CCA and 8.1 days after. Mortality within 30 days was 7.3% before the CCA and 7.5% after. There were no significant differences between the periods before and after. In an analysis assessing the overall linear time trend 2 of 21 regions showed a reduction in readmissions and 10 in length of stay.

CONCLUSIONS: After introducing the CCA, no detectable impact was found on readmissions or mortality for patients with heart failure, which is in line with previous studies, such as those studying the US Hospital Readmission Reduction Program. Although no overall association with length of stay could be identified, it was reduced in several Swedish regions. The heterogeneity between regions could be used to understand the specific components needed to achieve the reduction of readmissions in future studies.

Key Words: ambulatory care ■ health policy ■ heart failure ■ length of stay ■ patient readmission ■ Sweden

Delivering high-quality, cost-effective healthcare for patients with chronic diseases, including heart failure (HF), has become increasingly challenging.[1,2] Patients with HF form a heterogeneous patient group constituting a large health care burden 87% of whom had 3 or more chronic conditions in 2014.[3] Patients with HF today live longer, partly due to new medical regimens such as angiotensin receptor neprilysin inhibitor and sodium-glucose cotransporter 2 inhibitors, which have been shown to improve outcomes in patients with HF.[4,5] Planning long-term care for patients with HF is a challenge as reflected in their high readmission rates. Readmission rates for patients with HF vary widely between and within countries: in the United States, rates range from 17% to 35%,[6–11] in Australia, from 10% to 27%,[12] and in Sweden, from 18% to 26%.[13,14] Readmissions are understood to result from a complex interplay of medical and social factors.[6,15] Several programs with different methods have proven effective in reducing hospital readmissions.[16–18] Focusing on the HF patient group, various models of transitional care interventions have demonstrated positive effects.[19] Consequently,

Correspondence to: Robert S Kristiansson, MD, Department of Public Health and Caring Sciences, Uppsala University, Box 564, 751 22 Uppsala, Sweden. Email robert.kristiansson@uu.se

Supplemental Material is available at https://www.ahajournals.org/doi/suppl/10.1161/CIRCHEARTFAILURE.124.012567.
For Sources of Funding and Disclosures, see page 1287.

Circulation: Heart Failure is available at www.ahajournals.org/journal/circheartfailure

WHAT IS NEW?

- This study is the first to evaluate the impact of the Care Coordination Act, a large-scale national quality improvement initiative aiming to reduce 30-day readmission rates and hospital length of stay, for patients with heart failure.
- Implementation of the Act did not result in significant changes in 30-day readmission rates or length of stay among patients with heart failure at the national level.
- The study uncovers regional differences in both readmission rates and length of stay for patients with heart failure.

WHAT ARE THE CLINICAL IMPLICATIONS?

- System-wide policy interventions may not lead to measurable improvements in patient outcomes without concurrent local adaptation and multidisciplinary clinical leadership.
- Identifying regional differences and applying successful local strategies can guide clinical decision-making in efforts to reduce readmissions.
- Sharing effective clinical practices across regions can help standardize heart failure management, enabling clinicians to lead quality improvement initiatives and align heart failure care with the best practices nationwide.

Nonstandard Abbreviations and Acronyms

CCA	Care Coordination Act
HF	heart failure
HRRP	Hospital Readmission Reduction Program
NBHW	National Board of Health and Welfare

numerous countries have initiated large-scale programs to reduce readmissions. One example is the Hospital Readmission Reduction Program (HRRP) in the United States was initially reported as successful,[20,21] but later demonstrated a long-term increase in readmissions from 2010 to 2017.[7] The Swedish Care Coordination Act (CCA) was introduced in January 2018 with the aim of reducing length of stay and readmissions. The CCA is a mandatory hospital discharge model, overseen by dedicated nurses in the hospital, primary care, and social care. A recent study on the effects of the CCA concluded that the length of stay was reduced after the introduction of the CCA reform, but had no effect on 30-day readmissions for patients over 65 years.[22] Given that patients with HF are hospitalized more often and have more comorbidities than the average patient over 65 years,[23] it is pertinent to investigate its effects on readmission for the HF group.

Numerous initiatives aimed at reducing unplanned readmissions for patients with HF have been implemented and studied across different countries, including the large-scale HRRP in the United States, which incorporates monetary incentives, as well as various local initiatives in Europe focused on improving coordinated care. However, the impact of Sweden's CCA, which mandates collaborative care without relying primarily on monetary incentives, has only been evaluated in relation to a general patient cohort. The specific effects on patients with HF have not been adequately explored.

The aim of the study was to investigate the impact of implementing a national law, including mandatory communication processes, the CCA, on readmissions within 30 days and length of stay for multimorbid patients over 65 years of age with HF.

METHODS

Study Design

Interrupted time series analysis of hospital admissions using hierarchical mixed models to adjust for clustering.[24–26]

Data Source

The data set was acquired from the national registries managed by the National Board of Health and Welfare (NBHW), using individual patient admissions as the analytical unit. Data are available from the NBHW for researchers with appropriate ethics approvals, with reference to dnr 5102/2020, with results then being fully reproducible using code available in an online repository at https://osf.io/pq3jr/. The NBHW data are updated yearly based on electronic patient register data provided by each of the 21 Swedish regions. The main data set is the national inpatient care registry, including every hospitalization in the country. We extracted data from the period January 1, 2015 to December 31, 2019, for all individuals meeting the inclusion criteria. Data on 30-day mortality and outpatient care contacts were collected from the NBHW cause of death registry and outpatient care registry. Social/municipal care needs at the time of discharge were extracted from the NBHW Social services and municipal health services registries.

Sample Population

All patients +65 years who were admitted between January 1, 2015 and September 30, 2019 with a principal diagnosis of HF (*International Classification of Diseases* code I50) with at least 1 additional condition (comorbidity) were included. Patients were excluded if there were missing variables to perform data linkage or adjust for clustering, as well as patient stays over 90 days, and stays ending in the death of the patient.

Variables

NBHW provides the variables necessary to identify hospital admissions, hospital-based outpatient care contacts, and mortality. It also provides patient demographics, including age, sex, and municipality. The hospital admissions can be linked

to the region, discharging ward, and type and location of the hospital. *International Classification of Diseases, Tenth Revision* codes were used to identify Ambulatory care sensitive conditions according to Purdy et al.[27] The NBHW Social services and municipal health service registries were used to identify patients receiving social care in the form of in-home or nursing home care.

Exposure

The exposure of interest was time intervals in relation to the introduction of the CCA on Jan 1, 2018. The study timeframe was divided into 2 phases: (1) pre-CCA (2015–2017) and (2) CCA (2018–2019). The years after were excluded due to the start of the COVID-19 pandemic period in early 2020. There was a period when the intention of the law was known to all regions and caregivers in 2017. We considered both immediate level changes and trend changes in the outcomes in response to the exposure to be plausible.

Outcomes

In our study, patients with HF were assessed for 2 primary outcomes: all-cause unplanned readmissions within 30 days and length of stay. Patients with a planned admission as their first postdischarge contact were considered as negative for the unplanned readmission outcome per the CMS definition. Subgroup analyses were specified based on domain knowledge to evaluate variation across (1) regions, (2) municipal care needs, and (3) large university versus small regional hospitals. All of these analyses assessed 30-day readmission rates and length of stay.

Statistical Analysis

Descriptive analyses were reported using means and proportions as appropriate, and presented visually as time series using rolling mean values. An interrupted time series analysis using hospital admissions as the unit of analysis was performed using hierarchical mixed models with random intercepts clustered at the hospital ward level. In addition to models estimating the full direct effect of the intervention, case-mix adjusted models were used to assess for confounding by simultaneous interventions or population changes.[24–26] Case-mix adjustment was performed by including potential confounding or mediating factors as covariates in the base models. Case-mix adjusted models accounted for patient age, sex, marital status, type of admission (planned or unplanned), number of diagnoses/hospital interventions and the presence of an ambulatory care sensitive condition per the definition in Purdy et al.[27] We further considered that the intervention could have differential impacts for patients with and without previous social care services, and for patients admitted to large university hospitals versus smaller regional hospitals, and further controlled interrupted time series models were estimated to identify such effects. In the subgroup analysis investigating regional variation, overall linear trends in readmissions within 30 days and length of stay were investigated to limit the number of investigated parameters. All analysis was performed using R (v 4.4.0), with the full code, data dictionary, and region-level panel data available online in the online repository.[28] Ethical approval for this study was granted by the Swedish Ethics Review Authority (dnr 2019-04191).

RESULTS

Demographic and Clinical Characteristics

From 2015 to 2019, a total of 2 664 583 admissions to the hospital were identified. After the application of exclusion criteria and the identification of patients with a primary HF diagnosis, 111 414 admissions were included in the analysis. Of these, 26.8% had an unplanned readmission within 30 days, and the average length of stay was 8.3 days. The characteristics of the population are shown in Table 1. The mean age was 81.9 years, and the percentage of females was 45.2%. Almost two-thirds of patients (63.1%) had social service benefits in the form of living in a nursing home or having home care services at home, and the proportion increased slightly in the postintervention period. The average 30-day mortality rate was 7.4%.

Readmissions Within 30 Days, Mortality, and Length of Stay

Outcomes were evaluated both in terms of their immediate intervention effect (ie, abrupt level-change between the end of 2017 and 2018) and their effect on the longer-term trend (ie, the difference in the slope of the outcome measure before and after the reform). As illustrated in Figure 1, the average readmission rate within 30 days was 26,8% and there was no detectable difference (immediate intervention effect of 0.976 [95% CI, −0.874 to 3.329] and trend change of 0.049 [95% CI, −0.107 to 0.179] percentage points per month) between the periods before and after the implementation of the CCA. Length of stay averaged 8.4 days prereform, and although a downward trend can be qualitatively discerned (immediate intervention effect of −0.014 [95% CI, −0.377 to 0.313] and trend change of −0.017 [95% CI, −0.038 to 0.005] percentage points per month), it was not significant in the interrupted time series model. There were no significant differences in mortality rates, which was 7.3% before the CCA and 7.5% after (immediate intervention effect of 0.383 (95% CI, −0.862 to 1.599) and trend

Table 1. Descriptive Statistics With 95% CI

Parameter	Prereform	Postreform
No. of hospitalizations	71 225	40 189
Average age, y	81.9 (81.9–82)	81.9 (81.9–82)
Percent female	45.1 (44.8–45.5)	45.4 (44.9–45.9)
Percent social care	62.7 (62.3–63.1)	63.8 (63.3–64.3)
Percent treated at university hospital	19.8 (19.6–20.1)	19.8 (19.6–20.1)
Percent mortality within 30 d	7.3 (7.1–7.5)	7.5 (7.2–7.8)
Average length of stay, d	8.4 (8.3–8.5)	8.1 (8–8.1)
Percent readmission within 30 d	26.8 (26.5–27.1)	26.7 (26.3–27.1)
Percent readmission within 30 d with heart failure	12.3 (12.1–12.6)	12 (11.7–12.3)

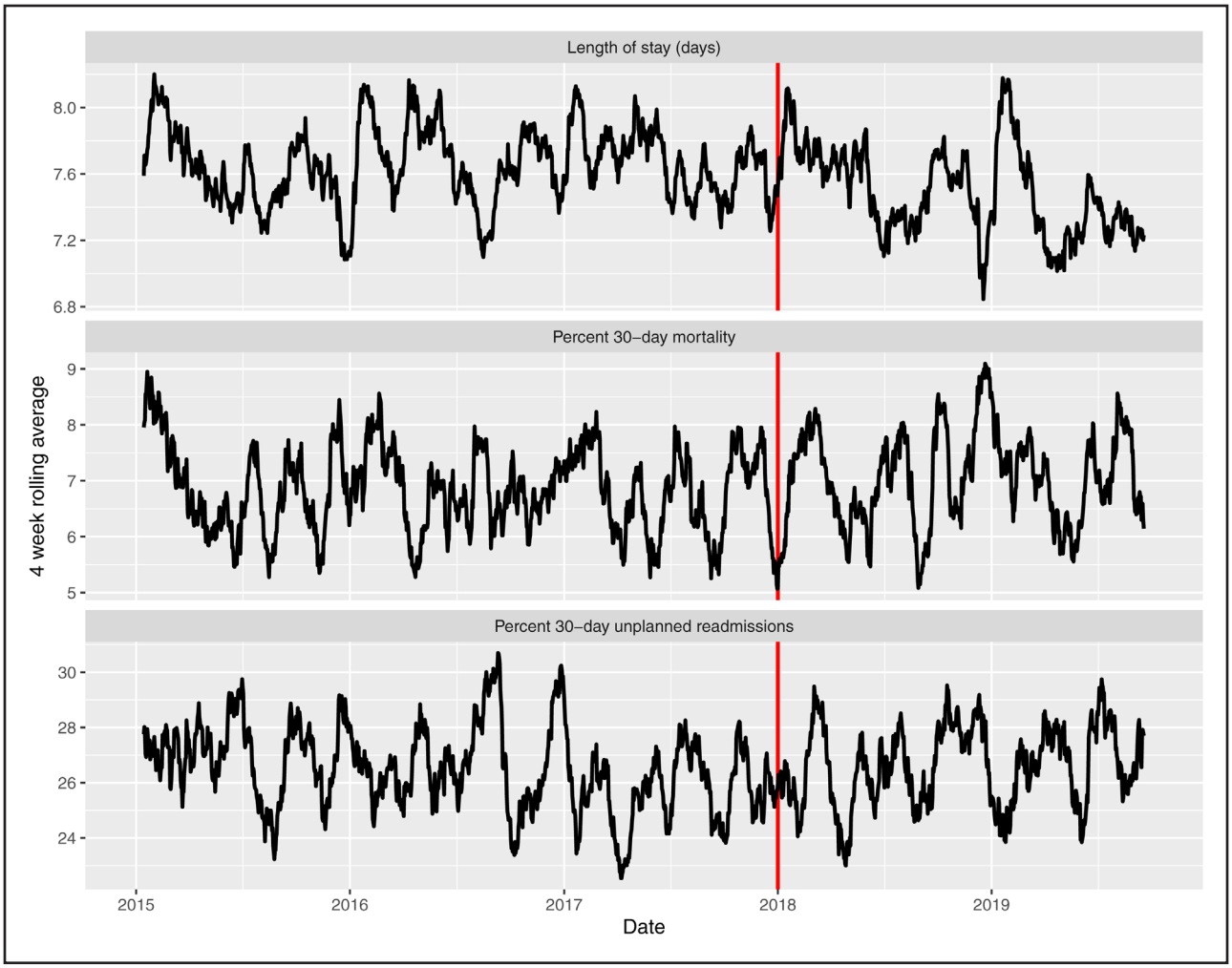

Figure 1. Time series of national-level trends in length of stay, 30-day mortality, and 30-day readmissions, with the red line denoting the introduction of the Care Coordination Act.

change of 0.034 (95% CI, −0.048 to 0.119). All identified intervention effects were nonsignificant (P>0.05). Further analyses investigating differences, adjusting for confounding patient characteristics, between patients with and without social care services and between large and small hospitals, also failed to identify statistically significant effects. Table 2 below reports the model coefficients for the fully adjusted model. Unadjusted model coefficients may be found in Table S1.

Region-Level Analysis

When examining the 21 regions individually, substantial variation may be discerned both regarding readmission rates and length of stay as shown in Figure 2. There are 3 large regions with appr 2 million citizens each (Stockholm, Västra Götaland, and Skåne), whereas the rest are smaller with 200 000 to 450 000 inhabitants. In an analysis assessing only the overall linear trend, that is, without an interruption at the 2018 introduction of the CCA, significant reductions in length of stay over the time period were identified for 10 of the 21 regions and increases in length of stay in a single region. A similar analysis conducted regarding readmissions identified significant reductions in only 2 out of 21 regions, with 1 region having a significant increase. These 2 regions stand out having a reduction in both 30-day readmissions and length of stay.

Table 2. Adjusted Model Coefficients

Coefficient	30-Day unplanned readmission (%)	Inpatient length of stay, d	30-Day mortality (%)
Per month trend	−0.061 (−0.131 to −0.002)	−0.019 (−0.028 to −0.009)	−0.012 (−0.05 to 0.025)
Intervention level—change	0.976 (−0.874 to 3.329)	−0.014 (−0.377 to 0.313)	0.383 (−0.862 to 1.599)
Per month postintervention trend change	0.049 (−0.107 to 0.179)	−0.017 (−0.038 to 0.005)	0.034 (−0.048 to 0.119)

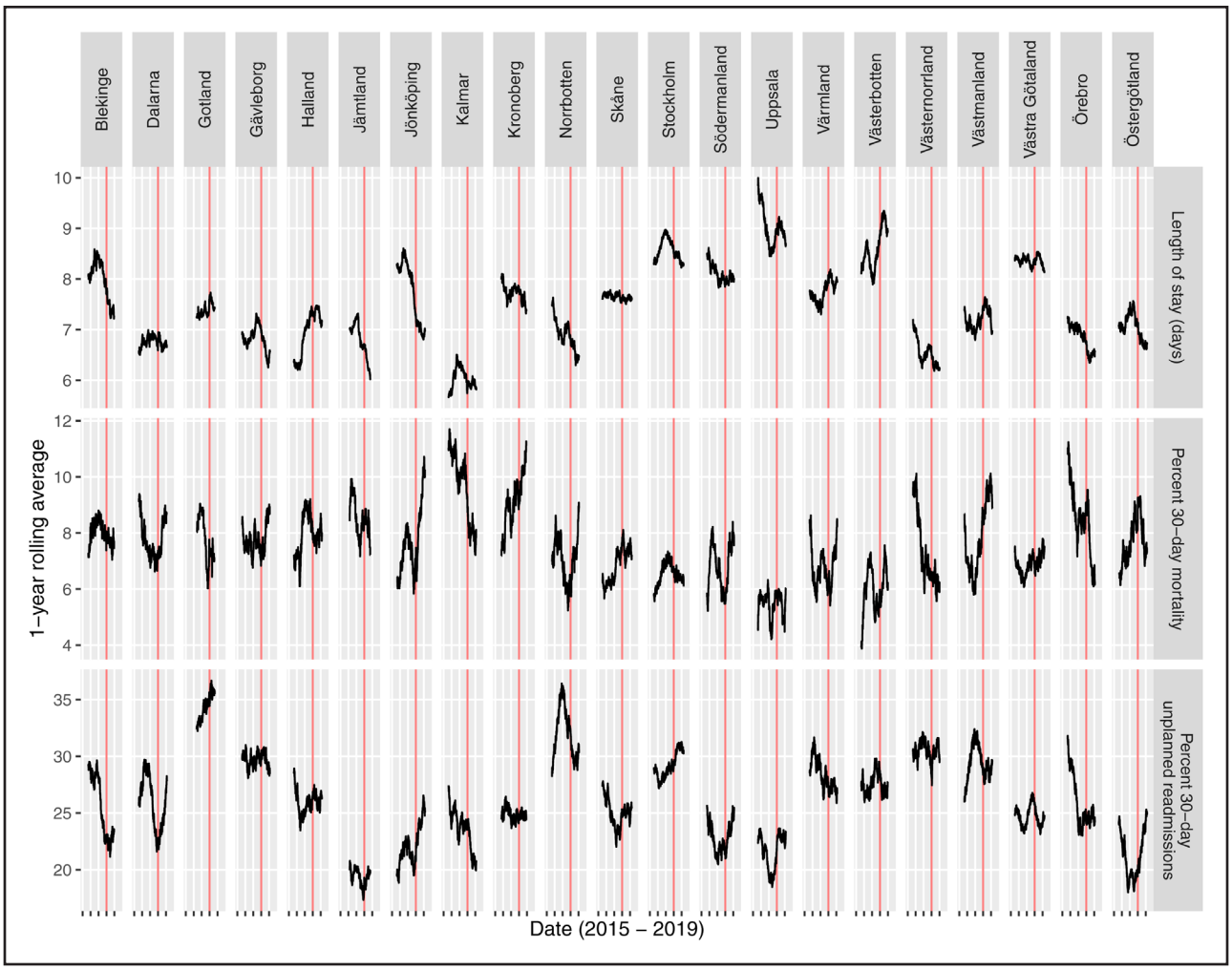

Figure 2. Time series of region-level trends in length of stay, 30-day mortality, and 30-day readmissions, with the red line indicating the introduction of the Care Coordination Act.

Additional Analyses

Several additional analyses were performed to evaluate the sensitivity of the findings to alternative specifications. Given the lack of a control group, the analysis is susceptible to history bias caused by the impact of events occurring simultaneously with the reform. To mitigate this, an analysis of the differential impacts of the reform on patients with and without municipal social care (of whom the former are more impacted by the reform) as well as on older versus younger patients was performed. We identified no significant differential impacts in this controlled time series analysis. The potential effects of the reform on only HF-related readmissions were also investigated, with effects found to be similar to those identified in the main analysis. The full results of all additional analyses are available in Tables S2 through S5, as well as the data repository.[28]

DISCUSSION

The aim of the study was to investigate the impact of implementing a national reform, the CCA, on readmission, mortality, and length of stay for patients over 65 years of age with HF. We identified no statistically significant impacts on a national level after the implementation. Although the length of stay in the undifferentiated population was found to be reduced due to the CCA,[22] this effect was not significant among patients with HF alone.

The goal of the CCA was to improve the discharge process by involving primary care and social care providers during the patient's hospitalization and improving coordination between caregivers after discharge, resulting in lower readmissions as well as shorter lengths of stay.

However, we could not identify an effect on readmissions or mortality in our study. Focusing on the components of the CCA, there might be several explanations to why the expected system effects were not achieved. First, the CCA mandated processes may have displaced existing, relatively well-functioning care coordination processes. The process was digitally automated, with verbal communication or joint planning conferences used only when necessary. Second, the mandated postdischarge individual care planning conferences central to the reform may not be occurring to the desired extent.

Since the reform, such conferences have been reported to be performed in only 1% of cases.[29] Third, the incentives introduced by the reform may be misaligned with the responsibilities and interests of the actors intended to implement it.

Effects on Readmissions and Length of Stay of Larger National Programs—HRRP and CCA

Internationally, the CCA can fruitfully be contrasted with the HRRP in the United States, neither of which demonstrated long-term effects on readmissions. Both were large-scale, highly resourced programs, and therefore interesting to compare regarding both program theory of change and impacts. Initial studies suggested that implementation of HRRP was associated with a decrease in HF readmissions.[20,30] However, in 2021, Khan et al[7] found that there was no long-term reduction in readmission rates after the withdrawal of financial incentives, instead identifying that both 30- and 90-day readmission rates were higher during the post-HRRP penalty period compared with the pre-HRRP penalty phase. In our study, we similarly show that the CCA did not have any overall impact on readmissions for patients with HF.

The rationale behind the HRRP model was to establish a clear goal: Lowering readmissions to a certain level, and leaving it to the individual health care systems to achieve this objective. The theory posited that local systems would adapt according to their own capabilities to reach this goal, allowing ample room for local improvement.

The Swedish CCA had a different theory of change, focusing on specific discharge processes. By implementing mandatory steps that had previously been shown to improve collaborative care, reduce readmissions, and shorten length of stays, it was believed that the CCA would achieve these goals. In contrast to the HRRP, there was no specific predetermined target for readmissions, nor conditional financial incentives.

The national CCA and the HRRP were both large programs targeting millions of patients; however, neither was able to support improvement at a system level. Neither the monetary incentives of the HRRP nor the mandated care processes of the CCA seem to be sufficient to drive systematic change and reduce readmissions in the long term. For large-scale programs to be effective, they require robust support and continuous monitoring to ensure their impact and provide the healthcare system with opportunities to improve the program during its implementation.

Limitations

A strength of this study is the use of a national data set including every relevant hospitalization in the country. Another strength is the method, an interrupted time series analysis at the hospital admission level, allowing the identification of level and trend changes with a high level of power. There are also limitations. Primary care data that could be used to adjust the model were not available. Another limitation in this study was that we had no means to investigate the fidelity of the implementation to the guidelines stipulated in the CCA; hence, we do not know which mandatory steps had actually been taken before or after the introduction of the CCA. To understand a national program like the CCA, further studies are needed to investigate the extent to which the mandatory steps were implemented, which other care models were employed, and whether the differential implementation of the CCA may explain the regional variation identified here. A further limitation is the lack of specificity in the *International Classification of Diseases*, *Tenth Revision* codes available in the research data set, which precluded the separation of hospitalizations regarding acute and chronic HF exacerbations. Finally, we did not have access to patient-level medication changes. During the study period, new guidelines regarding drug treatments of patients with HF were introduced.[4] From 2017 to 2021, the overall progressive increase in angiotensin receptor neprilysin inhibitor use increased from 8.3% to 26.7%, which could result in history bias regarding the estimation of postintervention trend changes.[31] Despite this, improvements in HF outcomes regarding readmission or mortality can not be seen in our study. The ability to track adherence to medical regimens would be a valuable factor to include in a subgroup analysis.

Conclusions

In this study of a nationwide reform, the CCA, we found no significant change in readmissions within 30 days after discharge for patients with HF, and only a limited, regionally heterogeneous effect on length of stay. Thus, neither the US HRRP nor the Swedish CCA appears to have had a positive impact on readmissions over time for patients with HF. Previous research suggests that nationwide programs have the potential to support the improvement of HF care as measured by reduced 30-day readmission rates. However, it is unclear to what extent the national guidelines are accepted and used, and which other programs run in parallel to the national guidelines. Primary care plays a crucial role in effecting the timely, coordinated ambulatory care needed to prevent hospital readmission, and must be included as part of the planning and execution of postdischarge HF care. Nonetheless, the CCA does not seem to have resulted in a system-wide reduction in hospital readmission rates for patients with HF.

ARTICLE INFORMATION

Received October 24, 2024; accepted September 15, 2025.

Affiliation

Department of Public Health and Caring Sciences, Uppsala University, Sweden.

Sources of Funding

Financial support for this study was provided by a grant from the Swedish Research Council for Health, Working Life and Welfare (dnr 2018-00783).

Disclosures

None.

Supplemental Material

Tables S1–S5

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