# Effectiveness of A 24-h Access Outpatient Clinic for Patients with Chronic Conditions in Hospital Outpatient Follow-Up: A Registry-Based Controlled Cohort Study of Healthcare Utilisation and Mortality

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## Abstract

**Background:** In 2015, Regional Hospital Silkeborg in Denmark introduced a 24-h telephone access hospital outpatient clinic (24-h access clinic). The 24-h access clinic allowed patients to call the hospital outpatient clinic in case of an exacerbation of symptoms. The aim of this study was to evaluate the effectiveness of a 24-h access clinic in terms of healthcare utilisation and mortality in patients with chronic conditions.

**Methods:** This study was designed as a registry-based controlled cohort study. The 24-h access clinic was established at Silkeborg Regional Hospital in Central Denmark Region, and the five other regional hospitals served as comparison hospitals. We included patients in hospital outpatient follow-up with chronic obstructive pulmonary disease, congestive heart failure, atrial fibrillation/flutter, inflammatory bowel disease and chronic liver disease. Outcomes were hospital admissions, length of stay (LOS), intensive care unit assistance and outpatient visits, contacts to general practice, municipal home nursing and all-cause mortality. Follow-up was 18 months.

**Results:** The study included 992 24-h access patients and 3,878 usual care patients. For the five conditions combined, the 24-h access patients had fewer all-cause admissions (incidence rate ratio (IRR) = .81, 95% confidence interval (CI) = .71 to .92), general practice out-of-hours contacts (IRR = .81, CI = .71 to .92) and shorter LOS (IRR = .71, CI = .57 to .88), but the rate of all-cause outpatient visits was higher (IRR = 1.07, CI = .99 to 1.15). General practice daytime contacts were similar between the groups, and there was no significant difference in mortality.

**Conclusions:** A 24-h access clinic reduced acute admissions and LOS compared to usual outpatient care. Planned outpatient visits increased and substituted unplanned acute care, thus enhancing integration of care by allowing for access to the correct level of care and ensuring continuity of care.


## Background

The number of people living with chronic conditions is increasing [1] due to ageing populations, changes in risk factor exposure and early diagnosis of disease.[2, 3] This causes an increased demand for healthcare services delivered by multiple providers and specialities, resulting in fragmented care, poor patient outcomes and system inefficiencies.[4]

Integrated care may improve patient outcomes [5] and reduce healthcare costs.[6] Over the years, integrated care has been subject to numerous definitions.[7, 8] In brief, integrated care seems to promote patient-centred improvements in the delivery of care within and between providers.[9] Studies have shown that integrated care interventions can improve patient satisfaction, access to care and quality of life.[10] The results have been mixed for healthcare utilisation and costs.[9–12] Moreover, these interventions may often be contextually dependent, and results obtained in one setting may not necessarily translate to another.[13]

Provision of 24-h telephone access to hospital care for patients with complex chronic conditions can enhance integration of care.[14–16] Easy and flexible access to specialised assistance is among the highest priorities for patients with chronic conditions [17, 18] and may improve self-management.[19] In 2015, Regional Hospital Silkeborg in Denmark introduced a 24-h telephone access hospital outpatient clinic. Results of a before and after study indicated reductions in healthcare utilisation among patients with chronic conditions.[20] These findings were in line with earlier studies in the area.[14–16] However, none of these studies were performed using a controlled study design, which challenges the interpretation of the findings.[21]

The aim of this study was to evaluate the effectiveness of a 24-h telephone access outpatient clinic compared to usual outpatient care in terms of healthcare utilisation and mortality in patients with chronic conditions.

## Methods

## Study design and setting

The study was designed as a registry-based controlled cohort study conducted in Central Denmark Region, with a population of 1.3 million.[22] The 24-h telephone access outpatient clinic was established at Silkeborg Regional Hospital in 2015, and the five other regional hospitals in Central Denmark Region, Herning, Viborg, Holstebro, Horsens and Randers, served as comparison hospitals.

## The Danish healthcare system

Denmark is a northern European country with approx. 5.8 million inhabitants.[22] Healthcare is tax-financed, and Danes have free access to most healthcare services.[23] The Danish healthcare system is governed by the state, five regions and 98 municipalities. The regions run hospitals and reimburse general practitioners (GPs) and other primary care providers. GPs act as gatekeepers to specialised care, and 99% of the population are registered with a general practice, which they have to consult for medical advice. This also applies for out-of-hours care except for emergencies. Municipalities are responsible for elderly care and local healthcare promotion. Danish chronic care management is characterised by risk stratification based on severity.[24, 25] This implies that a majority of patients are primarily in general practice follow-up, while those with more complex needs are also in long-term hospital outpatient follow-up.

## The 24-h telephone access outpatient clinic

The 24-h access outpatient clinic allows patients in active hospital-based outpatient follow-up to call the hospital if they experience exacerbation or problems related to their chronic condition. Relatives, GPs and municipal healthcare professionals may call on behalf of patients. A specialised hospital nurse answers all calls and coordinates the patient's further course. If needed, a hospital physician is always available for assistance. Within the framework of shared

decision making, the nurse and the caller arrange the further course of action. This may include self-management assistance or help delivered at home by a municipal nurse-led acute team. If hospital care is needed, the patient is seen in the 24-h access outpatient clinic.

Access to the 24-h access outpatient clinic was granted to all patients in long-term outpatient follow-up at Silkeborg Regional Hospital with a primary diagnosis of atrial fibrillation and flutter (AF), chronic liver disease (CLD), chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF) and inflammatory bowel disease (IBD). Patients had to reside in Silkeborg Municipality because the 24-h access outpatient clinic was developed in a collaboration between hospital, municipality and GPs in Silkeborg Municipality. No additional funds were allocated for running the 24-h access outpatient clinic.

Patients were informed by regular mail about the 24-h access outpatient clinic. Patients were able to contact the clinic for further instructions, but no formalised education or instructions were provided.

## Usual care

Patients receiving usual outpatient care were treated at the five comparison hospitals as determined by regional policies after consultation with their GP or the GP out-of-hours services.(28) Initial acute hospital care was delivered by joint emergency departments (EDs) (29), with a subsequent transfer to a specialised ward if necessary. In some hospitals, cardiac patients received initial acute care in a specialised cardiac setting instead of an ED.

## Data sources

All information used in this study was obtained from Danish health and social registries.[26] All Danish residents have a personal identification number that links information about all health and social events from birth to death.[27] The following health and social registries were used. The Danish National Patient Register (DNPR), which contains information from all Danish somatic hospitals about inpatient contacts since 1977 and outpatient contacts since 1995.[28, 29] The Danish National Health Services Register (DNHSR), which contains information about all contacts to GPs.[30] The Municipal Home Nursing Registry, with information about home nursing delivered by municipalities.[31, 32] The Danish Civil Registration System (CRS), which holds information about gender, age, vital status, immigration and emigration and residence.[27] Finally, we used Statistics Denmark to determine highest obtained educational level.[33]

## Study population

All patients from Central Denmark Region were identified based on data from the DNPR. Patients were eligible for inclusion if they on the index date had been in hospital outpatient follow-up for at least 6 months with an International Classification of Disease, 10th revision (ICD-10) primary diagnosis of: AF (ICD-10: I48*), CHF (ICD-10: I110, I130, I132, I420, I426, I427, I428*, I429, I500*, I501*, I509), IBD (ICD-10: K50*, K51*), CLD (ICD-10: K658I, K702*, K703*, K704*, K711*, K717*, K72*, K73*, K74*, K754*, K761*, DK766*, K767, I85*) and COPD (ICD-10: J44, J440, J441, J449).

The 24-h access group was identified at Silkeborg Regional Hospital, while usual care patients were identified at the regional hospitals in Viborg, Herning, Holstebro, Randers and Horsens. Exclusion criteria were young age (AF: < 20, CHF: < 30, CLD: < 18, IBD: < 17 and COPD: < 35)[34–38], death within 6 months from index date and residence in a municipality other than the affiliated hospital.

## Index dates and follow-up

Index dates were guided by the dates on which the 24-h access outpatient clinic was started for each condition. Index dates were 17th August 2015 for COPD patients, 26th October 2015 for IBD and CLD patients and 2nd November 2015 for AF and CHF patients. Follow-up time was 18 months for all conditions.

## Descriptive variables

Descriptive variables included age, gender, Charlson co-morbidity index, highest obtained educational level and baseline utilisation the year before the index date. Charlson co-morbidity index included all in- and outpatient ICD-10 hospital diagnosis 10 years prior to the index date. All diagnoses of the qualifying chronic condition were excluded in the calculation of this measure. Highest obtained educational level was described by the International Standard Classification of Education 1997.

## Outcome variables

Information about all outcomes was obtained by the same methods for both groups and included nationwide utilisation data. Acute hospital utilisation included all-cause and exacerbation-related admissions and total length of stay (LOS) in bed days. Both acute inpatient admissions and ED contacts were considered as acute admissions. Exacerbations were identified by the assigned ICD-10 diagnosis code of the admission (Appendix 1.a). Use of intensive care assistance was recorded, identified by procedure codes (NABE and NABB) and the additional code (ATA1).[39] Intensive care could be given at an intensive care unit or on a regular bed ward. This accommodated for hospital differences in the organisation of intensive care. All-cause and disease-related outpatient visits were identified. A disease related visit was identified by the assigned ICD-10 diagnosis (Appendix 1.b).

General practice utilisation included daytime and out-of-hours contacts. These were identified by reimbursement codes (Appendix 1.c) in the DNHSR. As the reason-for-encounter is not registered in general practice, all contacts were included. Municipal home nursing was reported as acute or scheduled contacts. All-cause mortality at 18 months was based on any date of death retrieved from the CRS.

## Statistical analysis

Patient characteristics were reported by percentages for the categorical data. For continuous and count data, median and interquartile interval (IQI) or mean and standard deviation (SD) are given. Crude incidence rates (counts per person per year) of baseline healthcare utilisation were determined. We compared patient characteristics and baseline healthcare utilisation between 24-h access patients and usual care patients.

Analyses of healthcare utilisation outcomes were conducted separately for each of the five conditions and for all conditions combined. No formal sample size calculation was undertaken as this was a population-based study that included all eligible patients. The comparative analyses of healthcare utilisation were based on the intention-to-treat principle and included all eligible patients followed up for 18 months unless the patient was censored due to death or leaving the municipality during this period. We subtracted days hospitalised when calculating rates of outcome types that could not occur when hospitalised.[40]

Differences in healthcare utilisation between groups were estimated using a negative binomial regression model. We report incidence rate ratios (IRRs) with 95% confidence intervals (CIs) with robust standard errors. The models included gender, age, the Charlson comorbidity index, highest obtained educational level and baseline utilisation the year before the index date.

Mortality, reported by risk ratios, was analysed by pseudo-value regression analysis. We adjusted for gender, age, educational level and the Charlson comorbidity index. Cox regression did not comply with the proportional hazards assumption, which is not an assumption of pseudo-value regression.[41]

We hypothesised that the subgroup of patients with prior admissions (high-risk patients) would benefit more from a 24-h access outpatient clinic than patients with no prior admissions.[20] Thus, sensitivity analyses of healthcare utilisation were carried out among patients with no all-cause admissions in the year prior to index date and patients with at least one all-cause admission.

All analyses were conducted using the STATA 15 (StataCorp LP, College Station, TX, USA) statistical software.

# Ethics

According to Danish law, studies that are based on register data alone are not required to obtain permission from the regional ethics committees. This pertained to this study and was confirmed by the regional ethics committee (REF: 1-10-72-148-19). The Danish data protection agency approved the study (REF: 2009-41-3471).

## Results

We identified 11,213 patients with the relevant diagnoses. Of these, we excluded 6,211 patients (death within six months = 332 patients, short duration of outpatient follow-up = 1,988, young age = 31 patients and living in another municipality than the affiliated hospital = 3,992). The final analyses included 4,870 patients (24-h access patients = 992 and usual care patients = 3,878). For all conditions combined, the 24-h access patients were slightly older, had less general practice daytime and out-of-hours contacts, and more outpatient visits than the patients receiving usual outpatient care.(Table 1)

| | AF (n = 1,286) | | CHF (n = 602) | | CLD (n = 206) | | IBD (n =1,999) | | COPD (n = 777) | | All (n = 4,870) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 24-h (n = 270) | Usual care (n = 1,016) | 24-h (n = 123) | Usual care (n = 479) | 24-h (n = 50) | Usual care (n = 156) | 24-h (n = 385) | Usual care (n = 1,614) | 24-h (n = 164) | Usual care (n = 613) | 24-h (n = 992) | Usual care (n = 3,878) |
| **Patient characteristics** | | | | | | | | | | | | |
| **Female** | 35.9% | 36.5% | 25.2% | 30.9% | 52.0% | 66.0% | 53.3% | 53.6% | 51.8% | 55.6% | 44.8% | 47.1% |
| **Age,** mean (sd) | 70.9 (11.4) | 71.4 (10.7) | 70.0 (11.5) | 67.4* (12.2) | 60.8 (8.4) | 61.7 (10.9) | 49.8 (15.9) | 48.4 (16.1) | 71.3 (9.4) | 70.9 (10.0) | 62.1 (16.4) | 60.9* (17.1) |
| **CCI distribution** | | | | | | | | | | | | |
| None | 38.9% | 33.6% | 31.7% | 21.9% | 62.0% | 43.6% | 76.6% | 77.1% | 37.2% | 39.2% | 53.5% | 51.6% |
| Low | 40.4% | 42.7% | 43.9% | 47.0% | 26.0% | 36.5% | 18.7% | 18.4% | 40.9% | 35.2% | 31.8% | 31.7% |
| Moderate | 10.4% | 14.6% | 14.6% | 19.8% | 8.0% | 12.8% | 2.9% | 2.8% | 14.0% | 16.8% | 8.5% | 10.6% |
| High | 10.4% | 9.2% | 9.8% | 11.3% | 4.0% | 7.1% | 1.8% | 1.7% | 7.9% | 8.8% | 6.3% | 6.2% |
| **CCI,** median (IQI) | 1 (0-2) | 1 (0-2) | 1 (0-2) | 2* (1-3) | 0 (0-1) | 1* (0-2) | 0 (0-0) | 0 (0-0) | 1 (0-2) | 1 (0-3) | 0 (0-2) | 0 (0-2) |
| **Educational level** | | | | | | | | | | | | |
| Primary education | 31.6% | 37.6% | 41.3% | 42.0% | 37.5% | 49.4% | 23.4% | 24.3% | 48.2% | 58.9% | 32.7% | 36.4% |
| High school or vocational training | 39.9% | 40.4% | 38.0% | 44.3% | 45.8% | 38.3% | 50.4% | 47.9% | 42.1% | 33.6% | 44.4% | 42.9% |
| Higher education | 28.6% | 22.0%* | 20.7% | 13.7% | 16.7% | 12.3% | 26.3% | 27.8% | 9.8% | 7.5%* | 23.0% | 20.7% |
| | | | | | | | | | | | | |
| **All-cause utilisation rates[1] 12 months before index date** | | | | | | | | | | | | |
| **Hospital,** all-cause | | | | | | | | | | | | |
| LOS | 2.4 | 1.8 | 2.8 | 3.9 | 1.8 | 3.2 | .6 | .8 | 4.5 | 5.8 | 2.1 | 2.3 |
| Admissions | 1.0 | .8* | .8 | .9 | .7 | .8 | .2 | .3 | 1.0 | 1.3 | .7 | .7 |
| Outpatient visits | 11.1 | 6.4* | 12.2 | 10.9 | 7.7 | 6.1 | 5.9 | 5.2 | 9.7 | 8.1* | 8.8 | 6.7* |
| **General practice contacts** | | | | | | | | | | | | |
| Daytime | 15.6 | 19.3* | 15.9 | 18.3 | 12.8 | 13.3 | 8.4 | 8.8 | 18.5 | 21.0 | 13.2 | 14.8* |
| Out-of-hours | 1.4 | 1.3 | .8 | 1.5* | 1.2 | 1.4 | .9 | 1.0 | 2.0 | 3.1* | 1.2 | 1.5* |
| **Municipal home nursing contacts** | | | | | | | | | | | | |
| Scheduled | 13.0 | 18.9 | 5.2 | 20.2* | 17.5 | 20.2 | 1.2 | 2.9* | 31.4 | 44.7 | 10.7 | 16.5* |
| Acute | .2 | .3 | .1 | .6* | .4 | .3 | <.1 | .1* | .9 | .8 | .2 | .3 |

* Difference expressed by P-value < .05.
[1] Counts of incidences per patient per year.
Numbers may not add up to 100% due to rounding.
Abbreviations: AF; atrial fibrillation, CHF; congestive heart failure, CLD; chronic liver disease, IBD; inflammatory bowel disease, COPD; chronic obstructive pulmonary disease, 24-h; 24-h access patients, SD; standard deviation, CCI; Charlson co-morbidity index, IQI; interquartile interval, LOS; length of stay.

**Table 1.** Characteristics of patients with chronic conditions in a 24-h access clinic and usual care

The comparison of healthcare utilisation between 24–h access patients and usual care patients is presented in Table 2. For all conditions combined, the 24-h access patients had shorter all-cause LOS (IRR = .71, CI = .57 to .88) and fewer all-cause admissions (IRR = .81, CI = .71 to .92) than patients receiving usual

care. The tendency towards shorter LOS and fewer admissions among 24-h access patients was more pronounced for patients with CHF, CLD and IBD. For patients with COPD, there were no significant differences between 24-h access and usual care patients in these outcomes.

| | AF | | | CHF | | | CLD | | | IBD | | | CC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Crude rates[1] | | | Crude rates[1] | | | Crude rates[1] | | | Crude rates[1] | | | Cr |
| | 24-h | Usual care | Adj. IRR (95% CI)[2] | 24-h | Usual care | Adj. IRR (95% CI)[2] | 24-h | Usual care | Adj. IRR (95% CI)[2] | 24-h | Usual care | Adj. IRR (95% CI)[2] | 24 |
| **Hospital** | | | | | | | | | | | | | |
| **All-cause** | | | | | | | | | | | | | |
| LOS | 1.59 | 1.94 | .79 (.56-1.12) | 2.22 | 3.97 | .82 (.45-1.49) | 3.53 | 5.08 | .62 (.20-1.87) | .59 | 1.03 | .60 (.39-.92) | 5.2 |
| Admissions | .59 | .69 | .88 (.71-1.08) | .58 | .95 | .69 (.44-1.07) | .87 | 1.12 | .57 (.29-1.11) | .29 | .36 | .88 (.69-1.12) | 1.2 |
| Intensive care | .02 | .02 | .84 (.27-2.66) | .02 | .04 | .64 (.18-2.26) | .03 | .09 | .44 (.13-1.57) | <.01 | .01 | .22 (.01-1.38) | .04 |
| Outpatient visits | 8.12 | 5.75 | 1.30 (1.15-1.48) | 8.67 | 8.13 | 1.12 (.92-1.37) | 8.41 | 6.89 | 1.12 (.85-1.48) | 5.55 | 5.35 | 1.01 (.91-1.13) | 9.1 |
| **Exacerbations/ Disease related** | | | | | | | | | | | | | |
| LOS | .31 | .16 | 1.94 (1.18-3.18) | .42 | .67 | .31 (.12-.82) | .67 | 2.21 | .12 (.03-.43) | .16 | .28 | .57 (.29-1.13) | 2.8 |
| Admissions | .19 | .14 | 1.13 (.79-1.61) | .11 | .13 | .61 (.29-1.28) | .27 | .35 | .60 (.21-1.72) | .05 | .08 | .61 (.37-1.01) | .71 |
| Outpatient visits | 4.32 | 1.73 | 1.70 (1.40-2.07) | 3.05 | 2.16 | 1.07 (.87-1.31) | 4.34 | 2.33 | 1.59 (1.13-2.24) | 2.78 | 2.77 | 1.06 (.94-1.19) | 3.2 |
| **Primary care** | | | | | | | | | | | | | |
| **General practice contacts** | | | | | | | | | | | | | |
| Daytime contacts | 15.90 | 18.32 | 1.01 (.93-1.09) | 14.97 | 17.70 | .93 (.84-1.04) | 13.92 | 14.38 | 1.02 (.82-1.25) | 8.31 | 9.17 | .92 (.85-1.00) | 19 |
| Out-of hours contacts | 1.15 | 1.37 | .86 (.67-1.09) | .89 | 1.42 | .82 (.57-1.19) | 1.16 | 1.80 | .76 (.46-1.25) | .84 | .98 | .90 (.74-1.10) | 1.4 |
| **Municipal home nursing** | | | | | | | | | | | | | |
| Scheduled contacts | 11.08 | 20.42 | .40 (.23-.69) | 6.73 | 20.95 | .24 (.13-.47) | 12.49 | 25.06 | .10 (.04-.23) | .44 | 3.09 | .35 (.11-1.06) | 44 |
| Acute contacts | .17 | .56 | .76 (.34-1.73) | .14 | .81 | .26 (.09-.79) | .24 | .97 | .26 (.10-.67) | .01 | .13 | .23 (.07-.71) | 1.0 |

[1] Counts of the outcome per patient per year.
[2] Adjusted by gender, age, Charlson co-morbidity, highest obtained educational level and baseline status of the outcome.
Abbreviations: AF; atrial fibrillation, CHF; congestive heart failure, CLD; chronic liver disease, IBD; inflammatory bowel disease, COPD; chronic obstructive puln
IRR; incidence rate ratios, 95% CI; 95% confidence interval, LOS; length of stay.

**Table 2.** Healthcare utilisation in patients with chronic conditions in a 24-h access clinic and usual care

The 24-h access patients had more all-cause outpatient visits (IRR = 1.07, CI = .99 to 1.15) and disease-related outpatient visits (IRR = 1.23, CI = 1.13 to 1.34) than usual care patients (Table 2).

Rates of general practice daytime contacts were similar between groups for all conditions combined and for each condition separately (Table 2). For all conditions combined, the 24-h access patients had fewer out-of-hour general practice contacts (IRR = .81, CI = .71 to .92). This included a significant reduction in 24-h access patients with COPD (IRR = .48, CI = .36 to .64) and non-significant reductions in 24-h access patients with AF, CHF, CLD and IBD.

For all conditions combined, the 24-h access patients had less scheduled municipal home nursing (IRR = .60, CI = .36 to .99) and acute home nursing (IRR = .56, CI = .37 to .86) (Table 2). For patients with COPD and AF, rates of acute nursing were comparable between 24-h access and usual care patients.

There were no significant differences in mortality between 24-h access and usual care patients for all conditions combined or any specific condition (Table 3).

| | AF | CHF | CLD | IBD | COPD | All |
|---|---|---|---|---|---|---|
| **Crude risk** | | | | | | |
| 24-h access | .04 | .06 | .10 | <.01 | .15 | .05 |
| Usual care | .04 | .07 | .05 | <.01 | .17 | .05 |
| **Adjusted risk ratio[1],** (95% CI) | .99 (.97-1.02) | 1.02 (.98-1.06) | .95 (.86-1.04) | 1.00 (.99-1.01) | 1.02 (.95-1.10) | 1.00 (.99-1.01) |

[1] Adjusted by gender, age, Charlson co-morbidity, highest obtained educational level.

Abbreviations: AF; atrial fibrillation, CHF; congestive heart failure, CLD; chronic liver disease, IBD; inflammatory bowel disease, COPD; chronic obstructive pulmonary disease, 95% CI; 95% confidence interval.

**Table 3.** Mortality in patients with chronic conditions in a 24-h access clinic and usual care

The sensitivity analyses suggested that replacing hospital admissions with outpatient visits was more effective in 24-h access patients with at least one admission in the preceding year compared to no admission (Table 4).

| | AF | | | CHF | | | CLD | | | IBD | | | COPD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Crude rates[1] | | | Crude rates[1] | | | Crude rates[1] | | | Crude rates[1] | | | Crude rates[1] | |
| | 24-h | Usual care | Adj. IRR (95% CI)[2] | 24-h | Usual care | Adj. IRR (95% CI)[2] | 24-h | Usual care | Adj. IRR (95% CI)[2] | 24-h | Usual care | Adj. IRR (95% CI)[2] | 24-h | Usu care |
| **0 admissions in 12 mos. before index date** | | | | | | | | | | | | | | |
| **All-cause** | | | | | | | | | | | | | | |
| LOS | 1.06 | 1.34 | .79 (.43-1.47) | 1.42 | 1.94 | 85 (.39-1.84) | .13 | 2.91 | .33 (.09-1.30) | .47 | .65 | .72 (.44-1.19) | 4.37 | 4.04 |
| Admissions | .41 | .47 | .91 (.65-1.28) | .35 | .48 | .72 (.40-1.29) | .16 | .65 | 59 (.19-1.86) | .22 | .25 | .92 (.68-1.24) | .83 | .87 |
| Intensive care | .01 | .01 | .38 (.04-3.79) | .02 | .03 | 1.00 (.17-5.94) | 0 | .03 | N/A | 0 | .01 | N/A | .05 | .03 |
| Outpatient visits | 6.58 | 4.94 | 1.22 (1.03-1.45) | 6.11 | 5.61 | 1.06 (.84-1.34 | 6.83 | 5.55 | 1.25 (.88-1.78) | 4.97 | 4.65 | 1.06 (.93-1.20) | 7.94 | 5.66 |
| **Exacerbations/ Disease related** | | | | | | | | | | | | | | |
| LOS | .14 | .10 | 1.62 (.80-3.28) | .18 | .34 | .15 (.04-.61) | 0 | .99 | N/A | .13 | .22 | .66 (.29-1.47) | 2.20 | 2.30 |
| Admissions | .09 | .08 | 1.18 (.66-2.10) | .03 | .07 | .37 (.10-1.38) | 0 | .16 | N/A | .03 | .05 | .58 (.31-1.10) | .44 | .43 |
| Outpatient visits | 3.09 | 1.61 | 1.38 (1.07-1.77) | 2.36 | 1.70 | 1.20 (.94-1.52) | 3.25 | 1.90 | 1.51 (1.08-2.11) | 2.66 | 2.44 | 1.10 (.96-1.25) | 2.93 | 1.94 |
| **1+ admissions in 12 mos. before index date** | | | | | | | | | | | | | | |
| **All-cause** | | | | | | | | | | | | | | |
| LOS | 2.12 | 2.79 | .76 (.52-1.11) | 3.21 | 6.85 | .80 (.38-1.69) | 9.18 | 9.89 | .65 (.25-1.69) | 1.16 | 2.59 | .44 (.24-.79) | 6.31 | 9.12 |
| Admissions | .77 | 1.00 | .78 (.60-1.00) | .87 | 1.64 | .65 (.36-1.15) | 2.09 | 2.21 | 1.14 (.53-2.43) | .58 | .78 | .79 (.55-1.13) | 1.69 | 2.14 |
| Intensive care | .03 | .03 | 1.29 (.41-4.08) | .01 | .06 | .49 (.06-4.09) | .08 | .25 | .58 (.07-5.05) | .01 | .02 | .61 (.07-5.03) | .04 | .05 |
| Outpatient visits | 5.58 | 1.89 | 1.37 (1.15-1.64) | 3.91 | 2.82 | 1.37 (1.07-1.76) | 6.19 | 3.32 | 1.20 (.83-1.74) | 8.22 | 8.18 | 1.00 (.81-1.23) | 3.56 | 2.37 |
| **Exacerbations/ Disease related** | | | | | | | | | | | | | | |
| LOS | .49 | .24 | 2.19 (1.15-4.16) | .73 | 1.13 | .32 (.09-1.12) | 1.78 | 4.95 | .37 (.11-1.27) | .31 | .52 | .57 (.21-1.60) | 3.68 | 5.96 |
| Admissions | .29 | .24 | 1.06 (.68-1.68) | .21 | .22 | .84 (.37-1.90) | .72 | .80 | 1.72 (.49-6.01) | .12 | .20 | .59 (.28-1.25) | 1.05 | 1.20 |
| Outpatient visits | 5.58 | 1.89 | 2.10 (1.60-2.75) | 3.91 | 2.82 | 1.64 (1.24-2.17) | 6.19 | 3.32 | 2.03 (1.23-3.34) | 3.32 | 4.12 | .93 (.73-1.17) | 3.56 | 2.37 |

[1] Counts of the outcome per patient per year.

[2] Adjusted by gender, age, Charlson co-morbidity, highest obtained educational level and baseline status of the outcome.

Abbreviations: AF; atrial fibrillation, CHF; congestive heart failure, CLD; chronic liver disease, IBD; inflammatory bowel disease, COPD; chronic obstructive pulm adjusted, IRR; incidence rate ratio, LOS; length of stay, mos; months.

**Table 4.** Sensitivity analyses of hospital utilisation in patients in a 24-h access clinic and usual care

## Discussion

In general, patients enrolled in a 24-h telephone access outpatient clinic had fewer acute hospital contacts and general practice out-of-hours contacts than patients in usual outpatient care. In contrast, similar or higher rates of hospital outpatient visits and general practice daytime contacts were seen among the 24-h access patients. No difference in mortality was observed. These results suggest that a 24-h access outpatient clinic could lead to greater use of planned outpatient care, thereby avoiding unplanned healthcare utilisation. The magnitude of this substitution was greater in the subgroup of patients with at least one admission in the preceding year.

# Limitations and strengths

The study has some limitations. We evaluated an already implemented intervention, and therefore a randomised controlled trial (RCT) was not an option. Bias due to systematic between-group differences is a threat in using an observational study design,[42] as this may lead to overestimation of effects.[43] To limit this bias, we studied patients within the same administrative region and adjusted our analyses for known health and social characteristics. However, there will inevitably be some residual confounding. The greatest risk may be confounding by indication if patients followed in the Silkeborg area differed from the others regarding the severity of the chronic condition. We included prior utilisation, comorbidity and age to adjust for such differences. Comparing the two groups with regard to baseline utilisation revealed some smaller differences in utilisation, in particular a higher use of outpatient visits and lower use of general practice services in the Silkeborg area.

Since our study was observational and based on registries, we were able to include all eligible patients and had no loss to follow-up.[44] Neither patients nor healthcare staff knew they were being observed and had no encouragement to select any particular course of action that might have affected outcomes in one way or another. In contrast, an RCT can be prone to performance and ascertainment bias.[45]

We used Danish national health registries, which are considered to be highly complete.[29] Validity of the included hospital ICD-10 diagnoses in terms of positive predictive values has been found to be satisfactory (range = 65–100%)[46–52]. We were unable to identify other studies investigating negative predictive values for the included diagnoses. Our use of all-cause outcomes allowed us to report estimates that were unaffected by the validity of the diagnoses. Results for municipal home nursing contacts should be cautiously interpreted because these are based on a registry that has not yet been validated.

Multiple estimates in the study should be cautiously interpreted due to the wide confidence intervals. This was particularly pertinent with regard to estimates of all-cause and exacerbation-related hospital admissions and LOS as well as use of intensive care assistance. The CLD group was the smallest group in this study, and estimates for this group should in general be cautiously interpreted.

# Interpretation

To our knowledge, only two prior studies have investigated the effect of 24-h telephone access to a hospital outpatient clinic in patients with chronic conditions. Both studies were based on COPD patients with prior exacerbations or advanced condition severity, and 24-h access was just one of several intervention components. In a before and after study, Hurst et al. found a 37% reduction in all-cause LOS.[14] Based on self-reporting, Roberts et al. found that 12% of the calls to a 24-h access clinic averted an emergency call.[15] In our sensitivity analysis of COPD patients with at least one admission in the preceding year, we found a reduction similar to that of Hurst et al. regarding all-cause LOS (IRR = .71, CI = .51 to 1.01). This reduction was not present in patients with no prior admissions. Differences in acute healthcare utilisation depending on prior admissions may be explained by familiarity with exacerbation symptoms. No or limited familiarity may lower the threshold for reaching out for help and thereby lead to unplanned acute care. However, this could provide a valuable opportunity for nurse-led supervision in a safe environment to help patients with a lack of knowledge understand symptoms and self-manage future exacerbations.

Our results suggest that a 24-h telephone access outpatient clinic substituted some unplanned admissions with planned outpatient visits by providing round-the-clock contact to nurses able to give professional advice and coordinate additional care. Such a change has been called for in the literature on ambulatory care sensitive conditions, proper ambulatory care being hypothesised to reduce unplanned acute care.[53] Unplanned acute admissions have been identified as a main driver of costs for patients with chronic conditions [54] and are considered a system failure in the delivery of chronic care.[55] Prior studies have reported mixed results for the association between planned ambulatory care and acute admissions [56–58], while higher levels of access and continuity of care have been identified as being strongly associated with reduced admissions.[59] Improving the access to care has been suspected to have a detrimental effect on utilisation if overused.[10] The results of this study did not indicate that a 24-h access outpatient clinic led to overuse of hospital care. Moreover, when both scheduled and acute care are delivered by the same provider, continuity of care may be enhanced and handovers avoided. Enhanced continuity of care is associated with improved patient satisfaction,[60] adherence to medications [61] and better health outcomes.[62] In contrast, handovers between healthcare professionals are susceptible to miscommunication and can threaten patient safety.[63]

Considering that only a few observational studies have to date investigated 24-h access to hospital care, future studies should investigate effects of this model of care in a randomised study design.

## Generalisability

Studies in Europe [14] and Australia [15] have described the results of 24-h telephone access for patients with chronic conditions, thus indicating the international relevance of a 24-h access clinic. In a Danish perspective, our results should be generalisable to other regions of Denmark. Danish Regions are considered homogeneous and results obtained in one region should be transferable to the others.[64]

## Conclusion

This registry-based controlled cohort study investigated the effects of a 24-h telephone access outpatient clinic on healthcare utilisation and mortality among patients with chronic conditions in hospital outpatient follow-up. The 24-h access patients had lower utilisation of acute hospital care and general practice out-of-hours contacts but more outpatient visits compared to usual care patents in the rest of the Region. No difference in mortality was observed. The results suggest that integrating care by means of 24-h telephone access clinic may lead to less unplanned acute care, which to some extent is substituted with planned outpatient care.

## Appendix 1.

**1a. Identification of disease related outpatient visits**

| Diagnosis | ICD-10 codes |
|---|---|
| AF | I48* |
| CHF | I110, I130, I132, I420, I426, I427, I428*, I429, I500*, I501*, I509 |
| CLD | K658I, K702*, K703*, K704*, K711*, K717*, K72*, K73*, K74*, K754*, K761*, DK766*, K767, I85* |
| IBD | K50*, K51* |
| COPD | J44, J440, J441, J449 |

Abbreviations: ICD-10; International Classification of Disease 10th revision, AF; atrial fibrillation, CHF; congestive heart failure, CLD; chronic liver disease, IBD; inflammatory bowel disease, COPD; chronic obstructive pulmonary disease

**1b. Identification of acute admissions due to exacerbations**

| Diagnosis | ICD-10 codes |
|---|---|
| AF | I48* |
| CHF | I110, I130, I132, I420, I426, I427, I429, I50* |
| CLD | K65*, K702*, K703*, K704*, K711*, K717*, K72*, K73*, K74*, K754*, K761*, K766*, K767, I85*, I864*, I982, R17*, R18*, C22* |
| IBD | K50*, K51*, R634, R10*, K30*, R64*, K20*, K21*, K221*, K25*, K26, K27, K28*, K29*, K315*, K566*, K625*, K630, K631*, K632*, K633, E43*, E44*, E46*, K908*, K909 |
| COPD | J44*, J96*, J13*, J14*, J15*, J16*, J17*, J.18* |

Abbreviations: ICD-10; International Classification of Disease 10th revision, AF; atrial fibrillation, CHF; congestive heart failure, CLD; chronic liver disease, IBD; inflammatory bowel disease, COPD; chronic obstructive pulmonary disease

**1c. Identification of general practice contacts**

| Contact type | Reimbursement codes | Time codes |
|---|---|---|
| Daytime | 0101, 0105, 0201, 0421, 0431, 0441, 0451, 0461, 0491 | 0–7 |
| Out-of-hours | 0101, 0102, 0471, 0501, 0602 | 8–9 |

## List Of Abbreviations

AF: Atrial fibrillation/flutter
CCI: Charlson comorbidity index
CHF: Congestive heart failure
CI: 95% confidence interval
CLD: Chronic liver disease
COPD: Chronic obstructive pulmonary disease
CRS: Danish Civil Registration System
DNHSR: Danish National Health Services Register
DNPR: Danish National Patient Register
ED: Emergency department
GP: General practitioner

IBD: Inflammatory bowel disease
ICD-10: International Classification of Disease, 10th revision
IQI: Interquartile interval
IRR: Incidence rate ratio
LOS: Length of stay
RCT: Randomised controlled trial
SD: Standard deviation

## Declarations

# Ethics approval

According to Danish law, registry-based research does not require approval by committees on biomedical research ethics, or informed consent. This was confirmed by The Central Denmark Region Committees on Health Research Ethics (REF: 1-10-72-148-19).

# Consent for publication

N/A

# Availability of data

The data that support the findings of this study are available from Statistics Denmark but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Statistics Denmark.

# Competing interests

The authors declare that they have no financial or non-financial competing interests.

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# Authors' contributions

ADM contributed to the design of the study and drafted the manuscript. UF, DHC and PV contributed to the design of the study and critically reviewed the manuscript.

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