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CLINICAL RESEARCH

Outpatient healthcare utilization 30 days before and after hospitalization for heart failure in France: Contribution of the national healthcare database (*Système national des données de santé*)

Consommation de soins de ville 30 jours avant et après une hospitalisation pour insuffisance cardiaque en France : contributions du Système national des données de santé

Sarah F. Feldman[a], Thomas Lesuffleur[a], Valérie Olié[b], Christelle Gastaldi-Ménager[a], Yves Juillière[c], Philippe Tuppin[a,*]

[a] *Caisse nationale de l'assurance maladie (CNAM), 75986 Paris, France*
[b] *Santé publique France, 94410 Saint-Maurice, France*
[c] *Cardiologie, Institut Lorrain du cœur et des vaisseaux Louis-Mathieu, 54500 Vandœuvre-lès-Nancy, France*

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Guidelines;
Heart failure;
Hospitalization;
Observational study;
Outpatient care

Summary
Background. — Guidelines have been published concerning patient management after hospitalization for heart failure. The French national healthcare database (*Système national des données de santé*; SNDS) can be used to compare these guidelines with real-life practice.
Aims. — To study healthcare utilization 30 days before and after hospitalization for heart failure, and the variations induced by the exclusion of institutionalized patients, who are less exposed to outpatient healthcare utilization.

Abbreviations: ACE, Angiotensin-converting enzyme; ALD, *Affection de longue durée* (long-term disease); ARB, Angiotensin II receptor blocker; HF, Heart failure; ICD-10, International Classification of Diseases, 10th revision; ICU, Intensive care unit; IQR, Interquartile range; SNDS, *Système national des données de santé* (national healthcare database).

* Corresponding author. Direction de la stratégie des études et des statistiques, CNAM, 26—50, avenue du Professeur André-Lemierre, 75986 Paris cedex 20, France.
E-mail address: philippe.tuppin@assurance-maladie.fr (P. Tuppin).

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Methods. — We identified the first hospitalization for heart failure in 2015 of adult beneficiaries of the health insurance schemes covering 88% of the French population, who were alive 30 days after hospitalization. Outpatient healthcare utilization rates during the 30 days after hospitalization and the median times to outpatient care, together with their interquartile ranges, were described for all patients, and for a subgroup excluding institutionalized patients.
Results. — Among the 104,984 patients included (mean age 79 years; 52% women), 74% were non-institutionalized (mean age 78 years; 47% women). The frequencies of at least one consultation after hospitalization and the median times to consultation were 69% (total sample) vs. 78% (subgroup excluding institutionalized patients) and 8 days (interquartile range 3; 16) vs. 7 days (3; 15) for general practitioners, 20% vs. 21% and 14 days (7; 23) vs. 16 days (9; 24) for cardiologists and 58% vs. 69% and 3 days (1; 9) vs. 2 days (1; 7) for nurses, with reimbursement of diuretics in 77% vs. 86%, angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers in 48% vs. 55% and beta-blockers in 55% vs. 63%. Departmental variations, excluding institutionalized patients, were large: general practice consultations (interquartile range 74%; 83%), cardiology consultations (11%; 23%) and nursing care (68%; 77%).
Conclusions. — Low outpatient healthcare utilization rates, long intervals to first healthcare utilization and departmental variations indicate a mismatch between guidelines and real-life practice, which is accentuated when including institutionalized patients.

MOTS CLÉS
Étude observationnelle ;
Hospitalisation ;
Insuffisance cardiaque ;
Recommandations ;
Soins de ville

Résumé
Contexte. — Des recommandations sont publiées sur la prise en charge après hospitalisation pour insuffisance cardiaque. Le système national des données de santé (SNDS) permet de les confronter à la vie réelle.
Objectifs. — Étudier les niveaux de prise en charge 30 jours avant et après une hospitalisation pour insuffisance cardiaque et les variations induites par l'exclusion des patients institutionnalisés, moins exposés aux consommations de ville.
Méthodes. — La première hospitalisation pour insuffisance cardiaque en 2015 des adultes, couverts par des régimes totalisant 88 % de la population, et vivants à 30 jours était retenue. Les taux de recours dans les 30 jours post-hospitalisation et les médianes de délais avec leurs intervalles interquartiles étaient décrits pour l'ensemble de la population d'étude et un sous-groupe excluant les patients institutionnalisés.
Résultats. — Parmi les 104 984 patients inclus (âge moyen 79 ans ; femmes 52 %), 74 % n'étaient pas institutionnalisés (âge moyen 78 ans ; femmes 47 %). La fréquence d'au moins une visite de généraliste post-hospitalisation était de 69 % (échantillon total) vs 78 % (patients non institutionnalisés) et le délai médian 8 jours (l'intervalle interquartile 3 ; 16) vs 7 jours (3 ; 15), cardiologue 20 % vs 21 % et 14 jours (7 ; 23) vs 16 jours (9 ; 23), infirmière 58 % vs 69 % et 3 jours (1 ; 9) vs 2 jours (1 ; 7), un remboursement de diurétiques 77 % vs 86 %, d'IEC ou ARAII 48 % vs 55 %, bêtabloquant 55 % vs 63 %. Les variations entre départements, hors institutionnalisation, étaient importantes : généraliste (l'intervalle interquartile 74 % ; 83 %), cardiologue (11 % ; 23 %), infirmière (68 % ; 77 %).
Conclusions. — Les faibles taux de recours, les délais élevés et les variations départementales indiquent une inadéquation entre vie réelle et recommandations, accentuée par l'inclusion des patients institutionnalisés.

Background

Heart failure (HF) is one of the leading cardiovascular diseases in terms of healthcare utilization and prevalence, affecting 1—2% of the adult population in high-income countries [1]. The annual incidence of HF (1—4.4/1000) is declining as a result of improved prevention, management and treatment of HF and its aetiologies [1,2]. However, HF remains the leading cause of hospitalization in the USA [1,3], where the median 1-year readmission rate for HF after a first hospitalization for HF was 22% in 2013 [1], with a 30-day mortality rate of 10.4% in the ARIC cohort [4].

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In France, the prevalence of HF is estimated to be 2.3% in adults [5]. In 2014, 165,000 patients were hospitalized at least once for HF, corresponding to a crude rate of 250/100,000 that remained relatively stable between 2002 and 2014 [6]. Marked geographical disparities are observed for hospitalization and mortality rates for HF [6]. In 2009, the readmission rate during the 30 days following discharge was 18% for all diagnoses combined and 5% for HF [7]. The cost of reimbursed healthcare in 2013 for individuals with HF was €2.5 billion (i.e. 2% of all national health insurance expenditure) [8].

Many studies have been conducted in patients with HF in order to identify risk factors predisposing to readmission for HF [9]. Programmes preparing discharge from hospital, comprising early outpatient follow-up, have been set up in order to optimize the patient's return home and limit the readmission rate [10,11]. In France, the Haute Autorité de santé published guidelines on the care pathway and outpatient management during the 30 days after hospitalization in 2014 and 2015 [12,13]. Deployment of the national healthcare database (*Système national des données de santé*; SNDS), which includes both outpatient and hospital healthcare, allows real-life evaluation of compliance with guidelines [14]. However, while a real-life study is often synonymous with a comprehensive population, the inclusion of certain subgroups with lower outpatient healthcare utilization or a global funding mode can impact estimation of the levels of healthcare utilization. This is the case for patients institutionalized in skilled nursing homes, psychiatric hospitals and rehabilitation units, as well as for short-stay hospitalized or deceased patients. As HF affects mostly elderly patients, exclusion of institutionalized patients from analysis is all the more relevant when evaluating compliance with HF guidelines.

The objectives of this study, based on SNDS data, were to report the levels of outpatient healthcare utilization during the 30 days before and after hospitalization for HF, according to the inclusion or exclusion of institutionalized patients and the presence of a history of HF.

Methods

Data source

The SNDS database collects the individual characteristics of the beneficiaries of the various national health insurance schemes, as well as prescriptions and procedures performed on an outpatient basis or in healthcare institutions and funded or reimbursed by French national health insurance [15]. The SNDS database does not record any clinical information concerning results relating to consultations, prescriptions or examinations. However, it includes information on the presence of long-term disease (*affection de longue durée* [ALD]) eligible for 100% reimbursement of healthcare for the disease concerned. Reimbursed drugs are identified by their Anatomical Therapeutic Classification (ATC) code, and procedures are identified by national nomenclatures. This information is individually linked by a pseudonymous identifier to information concerning private and public hospital stays recorded in the *programme de médicalisation des systèmes d'information* (PMSI; ''medical information systems programme''), specific to short-stay hospitals, rehabilitation units and psychiatric hospitals. The drugs dispensed and certain procedures performed during hospitalization, not reimbursed individually, cannot be identified. ALD status and hospital diagnoses are coded according to the International Classification of Diseases, 10th revision (ICD-10). An algorithm-based mapping tool is used to distribute beneficiaries into 56 non-exclusive co-morbidity or managed health state groups [14,16]. These algorithms were elaborated from ALD, hospital diagnoses, specific drugs and sometimes procedures, during or 4 years before the year considered. The RESID-EHPAD tool allows skilled nursing homes to provide national health insurance with their lists of residents and transfers.

Population and case identification

The main national health insurance scheme in France is the general scheme, which covers about 77% of the 66 million inhabitants; this proportion reaches about 86% with the addition of local mutualist section beneficiaries. The other main schemes are the ''agricultural workers scheme'' (*Mutualité sociale agricole*) and the ''self-employed workers scheme'' (*Régime social des indépendants*), together representing almost 10% of the population. Today, most studies conducted on SNDS data are limited to the general scheme with the addition of local mutualist section beneficiaries, because of the absence of certain data in the other schemes. Healthcare non-users, defined by the absence of reimbursed healthcare or health insurance coverage during a given year, are also often excluded from analyses, such as when using mapping algorithms.

Short-stay hospital stays in 2015 with a main diagnosis of HF (ICD-10 I.50) were identified among general scheme and local mutualist section beneficiaries. Short-stay hospital stays for adults, with admission and discharge in 2015 and a length of stay of at least 1 day, were then selected. Only the first HF hospitalizations of 2015 for each patient (the index hospitalization) were included in the study population, totalling 121,183 included patients. The frequencies of patients with at least one skilled nursing home, rehabilitation unit or psychiatric hospital stay were 10%, 5% and 0.2%, respectively, during the 30 days before the index hospitalization, and 12%, 16% and 0.2%, respectively, during the 30 days after the index hospitalization; 8% of these patients died during the index hospitalization, and 5.8% died during the following 30 days. These deceased patients were excluded from the total population, except for the analysis according to the outcome of the index hospitalization. Exclusion of deaths resulted in a total population of 104,984 patients, comprising 70,367 non-institutionalized patients, constituting the non-institutionalized subgroup. A patient was considered as institutionalized if a stay in a skilled nursing home, psychiatric hospital or rehabilitation unit occurred during the 30 days before and/or after the index hospitalization. Sample sizes and sociodemographic characteristics during these selection stages are reported in Table A.1. For the sensitivity analysis, another subgroup was created, excluding deceased patients, institutionalized patients and patients with a short-stay hospital stay 30 days before and/or after the index hospitalization.

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Table 1 Characteristics and co-morbidities of general scheme and local mutualist section beneficiaries hospitalized for heart failure in 2015, and of the subgroup of non-institutionalized patients, according to the presence of already managed heart failure.

	Non-institutionalized patients			All patients		
	Total	HF	Without HF	Total	HF	Without HF
	(*n* = 70,367; 100%)	(*n* = 26,983; 38%)	(*n* = 43,384; 62%)	(*n* = 104,984; 100%)	(*n* = 40,784; 39%)	(*n* = 64,200; 61%)
Age (years)	77.6 ± 11.7	78.5 ± 11.0	77.1 ± 12.1	79.2 ± 11.7	80.2 ± 10.9	78.5 ± 12.1
18–59 years	7.8	6.2	8.8	6.8	5.1	7.9
60–74 years	24.9	23.7	25.6	21.5	20.0	22.4
≥75 years	67.3	70.1	65.6	71.7	74.8	69.7
Female sex	47.3	46.2	48.0	51.8	51.3	52.1
Cardiovascular disease	70.6	100.0	52.3	70.3	100.0	51.5
Coronary heart disease	32.8	46.4	24.4	31.4	44.6	23.0
Stroke	7.8	9.6	6.7	8.6	10.5	7.3
LEAD	11.1	14.5	9.0	10.9	14.2	8.9
Arrhythmia	38.0	60.0	24.4	38.0	60.1	24.1
Valvular heart disease	12.9	22.3	7.0	12.9	22.5	6.9
Pulmonary embolism	0.4	0.6	0.3	0.5	0.6	0.3
Diabetes	34.6	40.0	31.2	32.6	37.3	29.7
Cancer	17.9	18.8	17.3	17.7	18.8	17.1
Mental illness	7.2	8.8	6.3	9.4	11.2	8.3
Neurological or degenerative disease	8.0	8.0	7.4	11.1	12.5	10.2
Dementia (Alzheimer's)	2.9	2.9	2.7	4.6	5.1	4.3
Parkinson's disease	2.1	2.1	2.1	2.5	2.5	2.4
Chronic respiratory disease	25.0	34.2	19.3	24.4	33.3	18.7
Chronic dialysis	1.1	1.1	0.8	1.0	1.4	0.8
Liver or pancreatic disease	3.7	3.7	2.7	3.5	5.0	2.6

Data are expressed as mean ± standard deviation or %. HF: heart failure; LEAD: lower extremity arterial disease.

Variables and definitions

The sociodemographic variables studied were sex and age. The patients' co-morbidities were determined by using the algorithm-based mapping tool. The presence of rehabilitation unit stay for all diagnosis and heart failure diagnosis was not based on rehabilitation unit's specificity. HF already managed before the index hospitalization, between 2010 and 2014, was identified by the HF-specific mapping algorithm. The presence of renal function tests was defined by the presence of reimbursement for urinary creatinine or serum creatinine assays or creatinine clearance. Hospital palliative care in a short-stay hospital was identified by the specific ICD-10 code and the code for palliative-care beds.

Data analysis

The results are presented in the form of frequencies of at least one reimbursed healthcare utilization during the target period. Medians and interquartile ranges (IQRs) (Q1; Q3) and the intervals between healthcare utilization before or after the index hospitalization (date of admission or date of discharge) were calculated for patients with at least one healthcare utilization. Departmental values of certain indicators for non-institutionalized patients, after adjustment for age and sex, were represented by maps, together with their medians and IQRs. Geographical correlations were studied by Pearson's correlation coefficient (*r*). The *Caisse nationale de l'assurance maladie*, as a health research institute, has permanent access to the SNDS database, approved by decree and the French data protection authority (*Commission nationale de l'informatique et des libertés*). Statistical analyses were carried out using SAS software, version 7.11 (SAS Institute Inc., Cary, NC, USA).

Results

Populations and characteristics

Restriction of the total population of 104,984 patients to the non-institutionalized subgroup of 70,367 patients resulted in a slight reduction of in mean age (79 years total vs. 78 years

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non-institutionalized) and in the proportion of women (52% vs. 47%) (Table 1), but also a slight reduction in the proportion of patients with neurological or degenerative disease (11% vs. 8%) and mental illness (9% vs. 7%) and, conversely, an increase in the proportion of patients with diabetes (33% vs. 35%). The proportions of patients with cardiovascular disease remained similar, at around 70%, with a history of HF in around 38% of patients in both the total population and the non-institutionalized subgroup.

Healthcare utilization of non-institutionalized patients

During the 30 days before the index hospitalization, the frequency of patients with at least one healthcare utilization was 72% for a general practice consultation, 11% for a cardiology consultation, 57% for nursing care and 21% for a B-type natriuretic peptide assay (Table 2). The median interval between the last healthcare utilization and hospitalization was −7 days for a general practice consultation (IQR −15; −3), −12 days for a cardiology consultation (IQR −20; −5), −2 days for nursing care (IQR −8; −1) and −7 days for a B-type natriuretic peptide assay (IQR −16; −3). The rate of at least one general practice consultation in the 30 days before the index hospitalization varied according to the department of residence, with higher rates in the *Sud*, *Sud-Ouest*, *Nord* and *Nord-Est* (Fig. 1), but with similar median intervals between the last consultation and hospitalization. The rate of cardiology consultations was higher in the *Grand Sud* and *Nord*. The rate of utilization of nursing care was higher in the *Centre* and *Nord-Ouest* than in the *Sud-Est*. The departmental rate of general practice consultations was correlated with the median interval between the last healthcare utilization and the index hospitalization ($r = 0.5$; $P < 0.0001$) and the rate of utilization of nursing care ($r = 0.71$; $P < 0.0001$), and was inversely correlated with the rate of cardiology consultations ($r = -0.26$; $P < 0.01$). At least one reimbursement for diuretics was identified in 59% of patients, for aldosterone antagonists in 10%, angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs) in 42% and beta-blockers in 46%. At least one all-cause hospitalization before the index hospitalization was identified for 12% of patients (median interval −14 days, IQR −21; −7), and admission to an intensive care unit (ICU) was identified for 4% of patients. During the index hospitalization, 28% of patients were admitted to an ICU. In this study, exclusion of institutionalized patients modified healthcare utilization rates during the 30 days preceding the index hospitalization, with a very slight increase in the rate of general practice consultations (71% total vs. 72% non-institutionalized), cardiology consultations (10% vs. 11%), nursing care (53% vs. 57%) and certain drug classes, but a decrease in the rate of physiotherapy (21% vs. 17%).

During the 30 days after the index hospitalization (Table 3), 78% of patients had at least one general practice consultation, 21% patients had at least one cardiology consultation and 69% received nursing care. The median interval between the index hospitalization and the first healthcare utilization was 7 days (IQR 3; 15) for general practice consultations, 16 days (IQR 9; 24) for cardiology consultations and 2 days (IQR 1; 7) for nursing care. Variations in the rates and intervals according to departments were similar to those reported for the 30 days before hospitalization (Fig. 2). At least one reimbursement for diuretics was identified in 86% of patients, for aldosterone antagonists in 19%, ACE inhibitors/ARBs in 55%, beta-blockers in 63% and a beta-blocker in combination with an ACE inhibitor/ARB in 40%, with variations according to departments. At least one all-cause readmission was identified for 21% of patients (mean length of stay, 15 days), and at least one readmission for HF was identified for 5% of patients. Exclusion of institutionalized patients also modified the rates of healthcare utilization: general practice consultations (69% total vs. 78% non-institutionalized), cardiology consultations (20% vs. 21%), nursing care (58% vs. 69%), diuretics (77% vs. 86%), loop diuretics (74% vs. 83%), ACE inhibitors/ARBs (48% vs. 55%) and beta-blockers (55% vs. 63%), with similar median intervals until healthcare utilization. The frequencies of 30-day all-cause readmission (23% total vs. 21% non-institutionalized), with variation according to departments (Fig. 3), and 30-day mortality (6% vs. 3%) both decreased.

Healthcare utilization in the presence of already managed HF (non-institutionalized patients)

Patients with known HF compared with patients with no known HF had a similar mean age (79 years known HF vs. 77 years no known HF), but a two-fold higher rate of coronary heart disease (46% vs. 24%) and an almost threefold higher rate of arrhythmia (60% vs. 24%) and valvular heart disease (22% vs. 7%) (Table 1). During the 30 days before the index hospitalization (Table 2), 75% of patients with known HF vs. 71% with no known HF had at least one general practice consultation, 12% vs. 11% had at least one cardiology consultation and 66% vs. 51% received nursing care. Patients with known HF more often had at least one reimbursement for ACE inhibitors/ARBs (45% known HF vs. 40% no known HF), diuretics (74% vs. 50%), loop diuretics (71% vs. 41%) and aldosterone antagonists (14% vs. 7%). During the 30 days after hospitalization (Table 3), the groups presented an identical rate of general practice consultations (78%), a similar rate of cardiology consultations (20% known HF vs. 22% no known HF) and a higher rate of nursing care in the known HF group (74% vs. 65%). The frequencies of certain drug classes increased after the index hospitalization, and became higher for patients with no history of HF compared with patients with a known history of HF: for example, ACE inhibitors/ARBs (56% no known HF vs. 54% known HF), diuretics (84% vs. 90%) and aldosterone antagonists (17%% vs. 23%). Patients with a history of HF were less often admitted to an ICU (26% known HF vs. 29% no known HF) during the index hospitalization (Table 2), but were more often readmitted for HF during the 30 days after hospitalization (7% vs. 4%) (Table 3).

Healthcare utilization before in-hospital death or ICU stay (non-institutionalized patients)

Patients who died in hospital were older than those discharged alive (83 vs. 78 years) and more frequently presented a history of HF (44% vs. 38%) (Table 4). During the

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Table 2 Healthcare utilization by general scheme and local mutualist section beneficiaries, and by the subgroup of non-institutionalized patients, 30 days before and during their first hospitalization for heart failure in 2015, according to the presence of already managed heart failure.

	Non-institutionalized patients			All patients		
	Total	HF	Without HF	Total	HF	Without HF
	(*n* = 70,367)	(*n* = 26,983)	(*n* = 43,384)	(*n* = 104,984)	(*n* = 40,784)	(*n* = 64,200)
General practitioner	72.3	75.2	70.5	70.9	73.5	69.3
Number of consultations	2 (1; 2)	2 (1; 2)	2 (1; 2)	2 (1; 3)	2 (1; 3)	2 (1; 2)
Time between last consultation and hospitalization (days)	−7 (−15; −3)	−7 (−15; −3)	−7 (−14; −3)	−7 (−14; −3)	−7 (−15; −3)	−7 (−14; −3)
Cardiologist	11.3	12.2	10.8	10.3	10.9	9.8
Number of consultations	1 (1; 2)	1 (1; 2)	1 (1; 2)	1 (1; 2)	1 (1; 2)	1 (1; 2)
Time between last consultation and hospitalization (days)	−12 (−20; −5)	−13 (−21; −5)	−11 (−20; −5)	−12 (−20; −5)	−13 (−21; −5)	−11 (−20; −5)
General practitioner or cardiologist	75.0	78.1	73.0	73.4	76.1	71.6
Number of consultations	3 (2; 4)	3 (2; 4)	3 (2; 4)	3 (2; 5)	3 (2; 4)	3 (2; 4)
Time between last consultation and hospitalization (days)	−7 (−14; −3)	−7 (−15; −3)	−7 (−14; −3)	−7 (−14; −3)	−7 (−14; −3)	−6 (−14; −3)
Nurse	56.5	65.6	50.8	52.9	60.3	48.2
Number of consultations	5 (1; 28)	7 (2; 30)	4 (1; 25)	6 (2; 28)	8 (2; 29)	5 (1; 26)
Time between last consultation and hospitalization (days)	−2 (−8; −1)	−2 (−7; −1)	−3 (−10; −1)	−2 (−9; −1)	−2 (−7; −1)	−2 (−9; −1)
Physiotherapist	17.0	19.4	15.5	20.5	23.1	18.8
Number of consultations	7 (4; 10)	7 (4; 10)	7 (4; 9)	7 (4; 10)	7 (4; 11)	7 (4; 10)
BNP assay	20.9	24.6	18.6	20.4	24.1	18.2
Time between assay and hospitalization (days)	−7 (−16; −3)	−8 (−17; −3)	−7 (−16; −3)	−7 (−16; −3)	−8 (−17; −3)	−7 (−16; −2)
Renal function tests	43.7	49.0	40.5	42.8	47.8	39.6
Outpatient or hospital procedure						

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Table 2 (*Continued*)

	Non-institutionalized patients			All patients		
	Total	HF	Without HF	Total	HF	Without HF
	(*n* = 70,367)	(*n* = 26,983)	(*n* = 43,384)	(*n* = 104,984)	(*n* = 40,784)	(*n* = 64,200)
Coronary angiography	0.5	0.4	0.5	0.5	0.5	0.6
Dilatation, stent or bypass graft	0.35	0.26	0.39	0.37	0.24	0.46
Pacemaker implantation	0.1	0.1	0.1	0.1	0.1	0.1
ICD placement	0.04	0.05	0.03	0.03	0.05	0.02
Medications						
Lipid-lowering agent	32.8	35.8	31.0	29.8	32.0	28.4
Antiplatelet agent	34.8	36.3	34.0	33.5	34.3	32.9
Anticoagulant	34.0	42.8	28.6	32.5	41.0	27.2
Diuretic	58.9	74.1	49.5	57.2	71.6	48.1
Loop diuretic	52.4	70.7	40.9	51.1	68.5	40.1
Aldosterone antagonist	9.7	14.0	6.5	8.7	12.6	6.2
Thiazide	7.8	4.1	10.1	7.3	3.9	9.4
ACE inhibitor	25.6	31.2	22.1	24.0	29.3	20.8
ARB	16.7	14.3	18.2	15.7	13.0	17.4
ACE inhibitor/ARB	42.0	45.2	40.0	39.4	42.1	37.7
Beta-blocker	46.1	54.7	40.7	43.6	51.6	38.6
Beta-blocker and ACE inhibitor/ARB	26.0	30.9	23.2	23.7	27.9	21.2
Beta-blocker and ACE inhibitor/ARB and aldosterone antagonist	3.0	4.9	1.8	2.6	4.2	1.6
Calcium channel blocker	21.7	20.4	22.5	20.2	18.8	21.0
Other antihypertensive	6.6	5.8	7.1	6.1	5.3	6.5
Nitrate	8.0	10.5	6.4	8.0	10.5	6.4
Central vasodilator	3.1	3.4	2.9	2.9	3.2	2.8
Peripheral vasodilator	0.6	0.5	0.7	0.6	0.4	0.7
Digoxin	4.4	5.7	3.6	4.3	5.8	3.5
Amiodarone	13.5	17.6	10.9	12.8	16.7	10.4
Ivabradine	1.8	2.6	1.3	1.6	2.3	1.2
All-cause hospitalization	11.5	11.8	11.3	12.8	12.9	12.7

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Table 2 (*Continued*)

	Non-institutionalized patients			All patients		
	Total	HF	Without HF	Total	HF	Without HF
	(*n* = 70,367)	(*n* = 26,983)	(*n* = 43,384)	(*n* = 104,984)	(*n* = 40,784)	(*n* = 64,200)
Time between last healthcare utilization and admission (days)	−14 (−21; −7)	−14 (−22; −7)	−14 (−21; −7)	−14 (−21; −7)	−14 (−22; −7)	−13 (−21; −6)
Mean length of stay (days)	9.3	9.7	9.0	10.3	10.7	10.0
Admitted via emergency department	9.4	10.8	8.5	10.9	12.4	10.0
ICU admission	3.5	3.6	3.4	4.0	4.0	4.1
Index hospitalization						
Mode of admission						
Admitted from home	96.7	97.1	96.5	91.1	91.2	91.1
Admitted via emergency department	74.3	73.4	74.8	75.8	75.0	76.3
ICU admission	27.7	25.8	28.9	28.0	25.7	29.5
Length of stay (days)	7 (5; 11)	7 (5; 11)	7 (5; 11)	8 (5; 12)	8 (5; 13)	7 (4; 12)
Procedures						
Coronary angioplasty, stent	0.8	0.6	1.0	0.7	0.5	0.9
Coronary angiography	3.7	2.0	4.7	3.2	1.8	4.1
Pacemaker implantation	0.5	0.4	0.5	0.4	0.4	0.4
ICD placement	0.5	0.5	0.5	0.4	0.4	0.4
Hospital palliative care	0.1	0.1	0.1	0.1	0.1	0.1

Data are expressed as % or median (Q1; Q3), unless otherwise indicated. ACE: angiotensin-converting enzyme; ARB: angiotensin II receptor blocker; BNP: B-type natriuretic peptide; HF: heart failure; ICD: implantable cardioverter defibrillator; ICU: intensive care unit.

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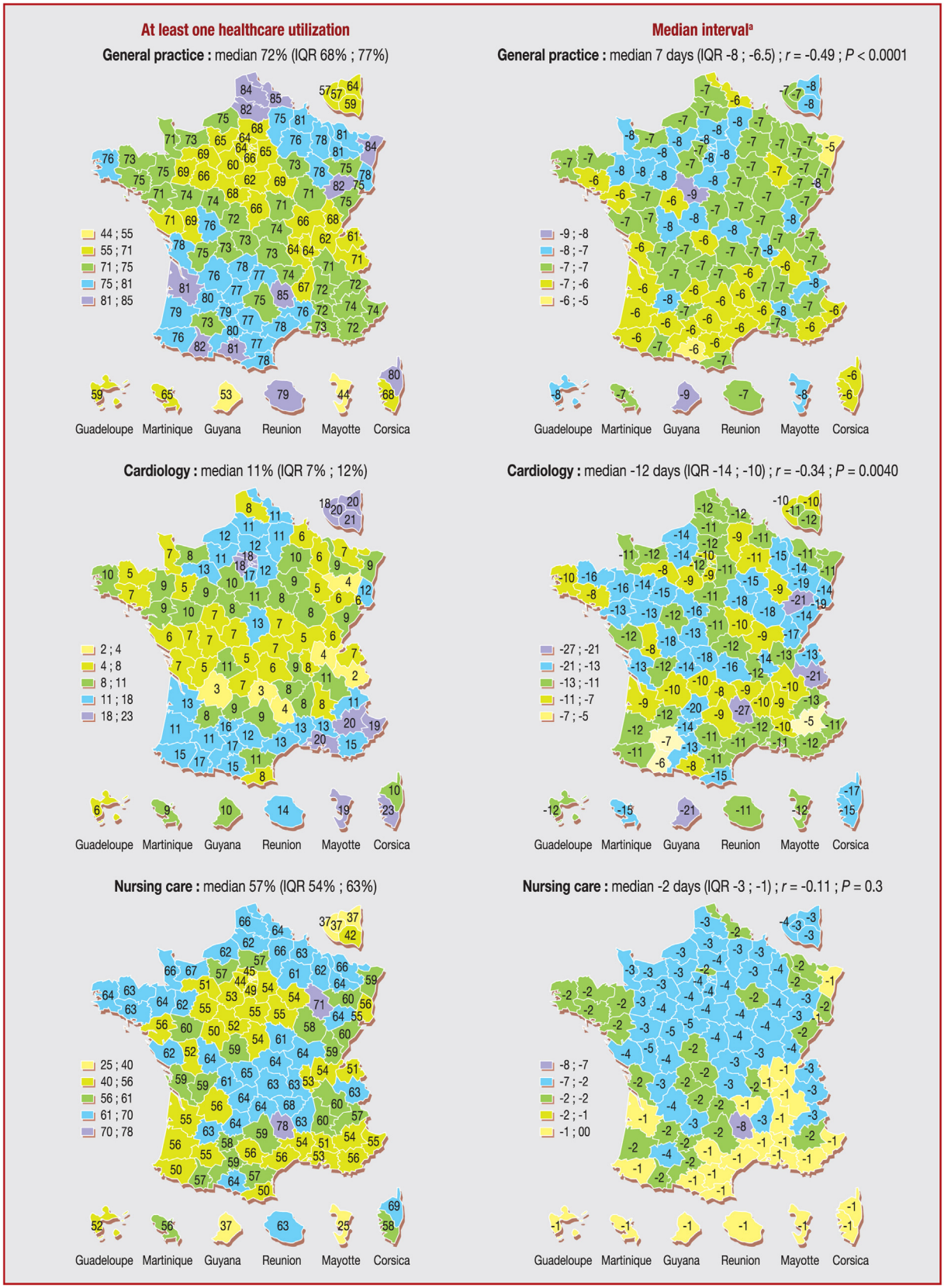

Figure 1. Age- and sex-adjusted frequency of at least one healthcare utilization by general scheme and local mutualist section beneficiaries 30 days before a first hospitalization for heart failure in 2015, and median interval between last healthcare utilization and hospitalization, according to department of residence. IQR: interquartile range (Q1—Q3); *r*: Pearson's correlation coefficient between the rate of healthcare utilization and the median interval between the last healthcare utilization and hospitalization. [a]For those with at least one healthcare utilization during the 30 days before hospitalization.

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Table 3 Healthcare utilization by general scheme and local mutualist section beneficiaries, and by the subgroup of non-institutionalized patients, 30 days after their first hospitalization for heart failure in 2015, according to the presence of already managed heart failure.

	Non-institutionalized patients			All patients		
	Total	HF	Without HF	Total	HF	Without HF
	(*n* = 70,367)	(*n* = 26,983)	(*n* = 43,384)	(*n* = 104,984)	(*n* = 40,784)	(*n* = 64,200)
General practitioner	77.9	77.9	77.8	68.5	68.7	68.4
Number of consultations	2 (1; 3)	2 (1; 3)	2 (1; 3)	2 (1; 3)	2 (1; 3)	2 (1; 3)
Time between hospitalization and first consultation (days)	7 (3; 15)	7 (3; 15)	7 (3; 15)	8 (3; 16)	7 (3; 16)	8 (3; 16)
Cardiologist	21.0	20.0	21.7	19.5	18.5	20.2
Number of consultations	1 (1; 2)	1 (1; 2)	1 (1; 2)	1 (1; 2)	1 (1; 2)	1 (1; 2)
Time between hospitalization and first consultation (days)	16 (9; 24)	16 (9; 24)	16 (9; 24)	14 (7; 23)	14 (7; 22)	14 (7; 23)
General practitioner or cardiologist	82.2	82.1	82.2	73.7	73.7	73.7
Number of consultations	3 (2; 4)	3 (2; 4)	3 (2; 4)	3 (2; 5)	3 (2; 4)	3 (2; 4)
Time between hospitalization and first consultation (days)	7 (3; 15)	7 (3; 15)	7 (3; 14)	7 (3; 16)	7 (3; 16)	7 (3; 16)
Nurse	68.5	73.6	65.4	58.3	61.5	56.3
Number of consultations	6 (2; 28)	8 (3; 29)	5 (2; 25)	6 (2; 23)	7 (2; 27)	5 (2; 20)
Time between hospitalization and first consultation (days)	2 (1; 7)	2 (1; 6)	3 (1; 7)	3 (1; 9)	3 (1; 8)	3 (1; 10)
Physiotherapist	19.3	21.7	17.9	23.1	25.3	21.7
Number of consultations	6 (3; 10)	7 (3; 10)	6 (3; 10)	7 (3; 11)	7 (3; 11)	7 (3; 11)
BNP assay	23.3	24.9	22.3	23.0	24.2	22.3
Time between hospitalization and assay (days)	12 (6; 20)	12 (6; 20)	12 (6; 20)	10 (5; 19)	10 (5; 19)	10 (5; 19)

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Table 3 (*Continued*)

	Non-institutionalized patients			All patients		
	Total	HF	Without HF	Total	HF	Without HF
	(*n* = 70,367)	(*n* = 26,983)	(*n* = 43,384)	(*n* = 104,984)	(*n* = 40,784)	(*n* = 64,200)
Renal function tests	62.0	64.4	60.6	56.6	58.3	55.5
Outpatient or hospital procedure						
Coronary angiography	1.1	0.7	1.4	1.7	1.0	2.1
Coronary angioplasty stent	0.4	0.28	0.53	0.6	0.4	0.8
Pacemaker implantation	0.2	0.19	0.2	0.2	0.2	0.2
ICD placement	0.03	0.03	0.02	0.04	0.0	0.1
Medications						
Lipid-lowering agent	41.0	42.0	40.3	34.5	34.5	34.4
Antiplatelet agent	38.6	38.4	38.7	34.7	33.8	35.3
Anticoagulant	50.8	55.5	47.9	44.6	48.6	42.1
Diuretic	86.2	89.9	84.0	76.7	79.6	74.8
Loop diuretic	83.3	88.0	80.4	74.1	77.8	71.7
Aldosterone antagonist	19.0	22.7	16.7	16.2	18.8	14.6
Thiazide	6.5	5.1	7.4	5.3	4.2	6.0
ACE inhibitor	39.4	40.4	38.7	34.2	34.5	34.0
ARB	16.7	14.6	18.0	13.8	11.9	15.0
ACE inhibitor/ARB	55.3	54.4	56.0	47.5	46.0	48.4
Beta-blocker	62.5	64.2	61.4	55.0	55.8	54.4
Beta-blocker and ACE inhibitor/ARB	39.6	39.6	39.7	33.6	32.9	34.1
Beta-blocker and ACE inhibitor/ARB and aldosterone antagonist	8.3	9.4	7.6	7.1	7.6	6.8
Calcium channel blocker	24.0	22.2	25.2	20.0	18.4	21.0
Other antihypertensive	6.3	5.8	6.6	5.2	4.8	5.5

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Table 3 (*Continued*)

	Non-institutionalized patients			All patients		
	Total	HF	Without HF	Total	HF	Without HF
	(*n* = 70,367)	(*n* = 26,983)	(*n* = 43,384)	(*n* = 104,984)	(*n* = 40,784)	(*n* = 64,200)
Nitrate	9.6	11.4	8.4	8.8	10.5	7.8
Central vasodilator	2.8	3.0	2.6	2.4	2.6	2.2
Peripheral vasodilator	0.4	0.3	0.5	0.3	0.3	0.4
Digoxin	6.2	7.0	5.8	5.5	6.3	5.1
Amiodarone	20.9	21.9	20.2	18.2	18.9	17.8
Ivabradine	2.1	2.7	1.7	1.8	2.2	1.6
All-cause readmission	21.0	23.0	19.9	22.9	24.3	22.0
Time to readmission (days)	14 (7; 22)	14 (7; 22)	14 (7; 22)	13 (6; 21)	13 (6; 21)	12 (5; 21)
Mean length of stay (days)	15.1	16.6	14.0	15.2	16.6	14.2
Admitted via emergency department	11.0	13.0	9.4	11.7	14.0	10.2
ICU admission	4.4	5.0	4.1	4.9	5.4	4.7
Readmission for HF	5.0	7.1	3.7	5.4	7.2	4.2
Time to readmission (days)	15 (7; 24)	16 (8; 24)	15 (7; 24)	14 (6; 23)	14 (7; 24)	13 (5; 23)
Palliative care	0.6	0.8	0.4	0.7	0.8	0.6
30-day mortality[a]	2387 (3.3)	1108 (3.9)	1279 (2.9)	6439 (5.8)	2997 (7.3)	3442 (5.4)

Data are expressed as %, median (interquartile range: Q1; Q3) or number (%), unless otherwise indicated. ACE: angiotensin-converting enzyme; ARB: angiotensin II receptor blocker; BNP: B-type natriuretic peptide; HF: heart failure; ICD: implantable cardioverter defibrillator; ICU: intensive care unit.
[a] Not included in the study.

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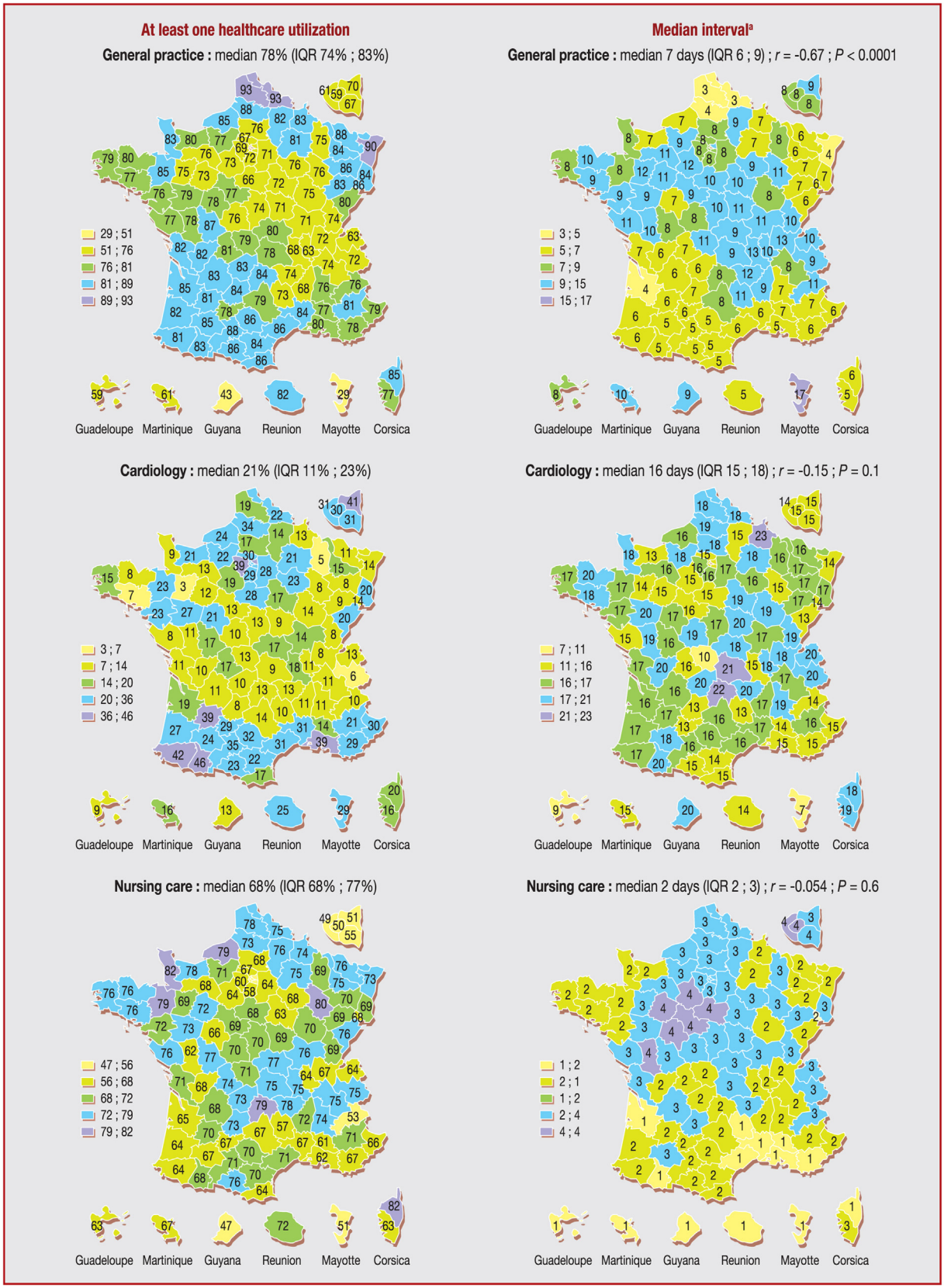

Figure 2. Age- and sex-adjusted frequency of at least one healthcare utilization by general scheme and local mutualist section beneficiaries 30 days after a first hospitalization for heart failure in 2015, and median interval to the first healthcare utilization after hospitalization, according to department of residence. IQR: interquartile range (Q1—Q3); *r*: Pearson's correlation coefficient between the rate of healthcare utilization and the median interval to the first healthcare utilization. [a]For those with at least one healthcare utilization during the 30 days after hospitalization.

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Table 4 Characteristics and healthcare utilization of general scheme and local mutualist section beneficiaries, 30 days before their first hospitalization for heart failure in 2015, according to the presence of in-hospital death or intensive care unit admission during the hospitalization.

	Deceased	Surviving	ICU	No ICU
	(*n* = 9760)	(*n* = 111,423)	(*n* = 34,889)	(*n* = 86,294)
All patients[a]				
Age (years)	84.5 ± 9.2	79.4 ± 11.7	76.5 ± 12.2	81.2 ± 11.0
Female sex	54.3	51.9	46.5	54.4
Institutionalized				
Rehabilitation unit	8.9	4.7	5.2	5.0
Rehabilitation unit cardiovascular diagnosis	2.7	1.1	1.3	1.2
Skilled nursing home	17.9	9.2	5.7	11.6
Psychiatry	0.3	0.2	0.2	0.2
ICU admission	37.7	28.0		
In-hospital death			10.5	7.1
Non-institutionalized patients[a]	7200 (73.8)	96,083 (86.2)	31,074 (89.1)	72,209 (83.4)
Age (years)	83.4 ± 9.6	78.4 ± 11.7	75.8 ± 12.2	81.1 ± 11.2
18–59 years	2.4	7.4	9.6	4.8
60–74 years	12.0	23.0	26.5	17.5
≥75 years	85.6	69.6	64.0	77.7
Female sex	49.7	51.0	53.5	45.0
HF before index hospitalization	44.3	38.3	36.0	39.9
Cardiovascular disease	73.3	69.8	67.9	72.1
Coronary heart disease	32.2	31.8	33.3	30.8
Stroke	8.8	7.9	7.6	9.0
LEAD	12.7	11.2	12.2	10.9
Arrhythmia	39.0	37.4	34.2	40.0
Valvular heart disease	16.2	13.0	13.4	13.4
Diabetes	30.5	33.6	35.5	30.8
Cancer	21.6	18.0	17.0	18.7
Neurological or degenerative disease	14.1	8.9	8.6	13.5
Dementia (Alzheimer's)	5.9	3.3	3.1	5.9
Parkinson's disease	3.0	2.2	2.1	2.8
General practitioner	77.5	72.5	67.6	72.2
Number of consultations	2 (1; 3)	2 (1; 2)	2 (1; 2)	2 (1; 3)
Time between last consultation and hospitalization (days)	−6 (−13; −2)	−7 (−14; −3)	−7 (−15; −3)	−7 (−14; −3)
Cardiologist	7.5	10.8	10.9	9.4
Number of consultations	1 (1; 2)	1 (1; 2)	1 (1; 2)	1 (1; 2)

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Table 4 (*Continued*)

	Deceased	Surviving	ICU	No ICU
	(*n* = 9760)	(*n* = 111,423)	(*n* = 34,889)	(*n* = 86,294)
Time between last consultation and hospitalization (days)	−13 (−21; −6)	−12 (−20; −5)	−12 (−21; −5)	−12 (−20; −5)
Nurse	65.8	57.4	49.3	54.4
Number of consultations	13 (2; 30)	6 (2; 29)	5 (2; 26)	7 (2; 29)
Time between last consultation and hospitalization (days)	−1 (−7; −1)	−2 (−8; −1)	−2 (−9; −1)	−2 (−8; −1)
BNP assay	24.1	21.0	20.1	20.9
Time between assay and hospitalization (days)	−8 (−17; −3)	−7 (−17; −3)	−8 (−17; −3)	−7 (−16; −3)
Renal function tests	48.5	43.9	42.0	43.6
Medications				
Antiplatelet agent	33.9	34.2	35.6	32.2
Anticoagulant	30.5	33.1	29.5	33.0
Diuretic	64.9	58.8	55.3	61.0
Loop diuretic	60.5	52.4	48.2	55.0
Aldosterone antagonist	9.2	8.7	8.6	8.8
Thiazide	6.1	7.7	8.0	7.5
ACE inhibitor	21.2	24.9	23.6	23.4
ARB	12.8	16.3	16.1	16.1
ACE inhibitor/ARBs	33.7	40.8	40.0	40.4
Beta-blocker	38.5	44.6	43.1	44.6
Beta-blocker and ACE inhibitor/ARB	17.9	24.8	24.6	24.1
Calcium channel blocker	17.9	21.1	21.5	20.6
Digoxin	5.1	4.5	3.4	4.9
Amiodarone	13.4	13.1	13.8	12.9
Ivabradine	1.7	1.8	2.1	1.6
All-cause hospitalization within 30 days	17.6	15.4	14.1	13.2
Time between last healthcare utilization and hospitalization (days)	−13 (−21; −6)	−14 (−21; −7)	−13 (−21; −6)	−14 (−21; −7)
Admitted via emergency department	11.7	8.1	8.5	8.4
ICU admission	3.3	3.0	4.7	2.3

Data are expressed as mean ± standard deviation, %, number (%) or median (interquartile range: Q1; Q3), unless otherwise indicated. ACE: angiotensin-converting enzyme; ARB: angiotensin II receptor blocker; BNP: B-type natriuretic peptide; HF: heart failure; ICU: intensive care unit; LEAD: lower extremity arterial disease.

[a] Including in-hospital deaths.

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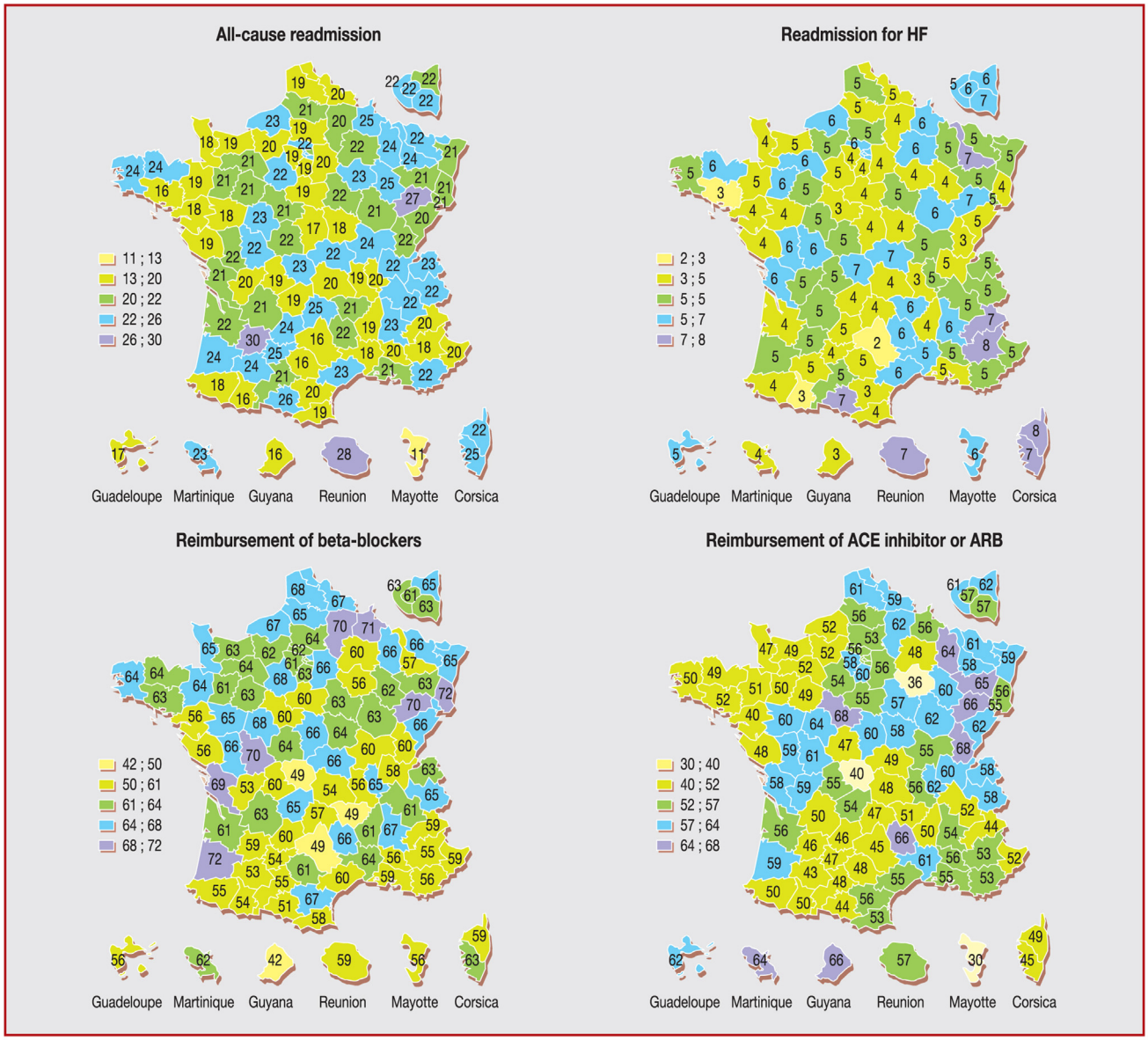

Figure 3. Age- and sex-adjusted frequency of at least one all-cause readmission or readmission for heart failure (HF) and reimbursement of drugs by non-institutionalized general scheme and local mutualist section beneficiaries 30 days after a first hospitalization for heart failure in 2015, according to department of residence. ACE: angiotensin-converting enzyme; ARB: angiotensin II receptor blocker.

30 days before the index hospitalization, they presented a higher rate of general practice consultations (78% vs. 73%) and were more often treated with a diuretic (65% vs. 59%); they were less frequently treated with an ACE inhibitor (21% vs. 25%) or a beta-blocker (39% vs. 45%). The median intervals between healthcare utilization and hospitalization were similar.

Patients admitted to an ICU were younger than those not admitted (76 vs. 81 years), and were more often women (54% vs. 45%); they less often had a history of cardiovascular disease (68% vs. 72%), particularly arrhythmias (34% vs. 40%), but more often had a history of diabetes (36% vs. 31%). The rates of healthcare utilization before the index hospitalization were lower among patients admitted to an ICU for general practice consultations (68% vs. 72%) and nursing care (49% vs. 54%), and slightly higher for cardiology consultations (11% vs. 9%). Median intervals to healthcare utilization before the index hospitalization were similar, as were the frequencies of the various drug treatments, except for a lower rate of diuretic use (55% vs. 61%).

Discussion

This study on outpatient healthcare utilization in a large population, 1 month before and 1 month after hospitalization for HF, shows a high rate of general practice consultations and nursing care, but with geographical variations. The rates and intervals observed reflect poor compliance with guidelines, both in terms of healthcare professionals and first-line treatment with ACE inhibitors/ARBs and beta-blockers. However, these rates vary according

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to the population selected, because of the characteristics and modalities of funding. Compliance with drug treatment guidelines is improved after hospitalization, even in patients with a history of HF before hospitalization. The main limitation of this study, based on the use of the ICD-10 code for HF, is the failure to differentiate between HF with preserved ejection fraction and HF with reduced ejection fraction.

Recommended healthcare follow-up and drugs

During the month before the index hospitalization, almost three-quarters of non-institutionalized patients had at least one general practice consultation, and 12% had at least one cardiology consultation. French guidelines for this prehospital setting require regular outpatient follow-up of patients with HF with reduced ejection fraction, with two to 12 general practice consultations per year and one to 12 cardiology consultations per year, depending on New York Heart Association stage and drug treatment with ACE inhibitors/ARBs and beta-blockers [12]. The guidelines for patients with HF with preserved ejection fraction are similar in terms of general practice consultations, but with only one to three cardiology consultations per year, together with management of co-morbidities [12]. Consultations may also be motivated by other cardiovascular or non-cardiovascular co-morbidities, frequently observed in older patients.

French guidelines recommend a general practitioner follow-up consultation within 7 days of discharge from hospital [13], as patients followed by their general practitioner after discharge from the emergency department have a lower mortality rate than those with no medical follow-up [17]. Nevertheless, in our study, only 78% of non-institutionalized patients consulted a general practitioner during the first month after discharge, and 82% when cardiology consultations were taken into account, but in both cases, only 50% had a follow-up consultation within 7 days of discharge. Short-stay hospital readmissions before and/or after the index hospitalization may also have limited outpatient healthcare utilization (21% of patients with an all-cause short-stay hospital stay during the month following discharge, with a median length of stay of 15 days). However, sensitivity analyses did not reveal any changes in the rates of healthcare utilization after exclusion of these patients. This can be explained by the fact that at least one drug dispensation or an isolated consultation during the 30 days after discharge from hospital is relatively probable despite a recent hospitalization.

Coordinated general practitioner-cardiologist management would more markedly decrease mortality in HF patients, regardless of HF stage, compared with management by a general practitioner alone [18]. The Haute Autorité de santé therefore recommends coordinated management between the general practitioner and the cardiologist [13], with a recommended follow-up visit by the cardiologist during the first 2 months after discharge from hospital for HF with reduced ejection fraction [12]. Although the present study only concerns the first 30 days after hospitalization, the follow-up visit rate of 21% appears to be low. Patients with no history of HF had a slightly higher rate of cardiology consultations and fewer identified cardiac co-morbidities, as reported in the literature [19].

The frequency of ACE inhibitor/ARB therapy was about 55%, despite the fact that this is the first-line treatment for HF with reduced ejection fraction. However, these drugs are also extensively prescribed to treat hypertension in patients with HF with preserved ejection fraction [20], a co-morbidity observed in 75% of these patients [21]. After hospitalization, the frequency of beta-blocker therapy was 62%, and the frequency of a combination of ACE inhibitors/ARBs and beta-blockers was 40%. The frequency of ACE inhibitor/ARB therapy was identical to that reported in 2009 for incident cases of HF, while the frequency of beta-blocker therapy was slightly increased [7]. The very high frequency of diuretic use can be explained by the fact that diuretics are prescribed regardless of the left ventricular ejection fraction, in the presence of symptoms of decompensation, such as peripheral oedema and acute pulmonary oedema, which often require admission to hospital. Nevertheless, frequencies of renal function tests could be considered as low, even after hospitalization.

Healthcare utilization rates among patients with known HF increased after discharge from hospital, with a higher rate of cardiology consultations (12% before vs. 20% after hospitalization) and a higher rate of reimbursement of numerous drug classes, including anticoagulants, aldosterone antagonists and, especially, ACE inhibitors and beta-blockers, essentially suggesting adaptation of treatment while the patient was in hospital.

Patients without known HF also had fewer cardiovascular co-morbidities, which can explain altogether a lower healthcare utilization rate before hospitalization, compared with patients with known HF; they were less frequently treated with diuretics and recommended treatments, such as ACE inhibitor/ARBs and, especially, beta-blockers; they also had more often undergone coronary angiography before and during hospitalization. Therefore, this first hospitalization for HF, without previous ALD status, may have been the result of sudden decompensation of HF, related to a triggering factor or a cardiovascular event.

Healthcare utilization and in-hospital adverse events

Patients admitted to an ICU during their index hospitalization differed from the other hospitalized patients. According to the available data, they mainly differed in terms of younger age, a lower frequency of cardiovascular diseases, including already known HF, but a higher frequency of diabetes, which is known to worsen prognosis of HF [22]. Their stage of HF was possibly less advanced in view of the lower rate of arrhythmias and lower frequency of diuretics, especially loop diuretics, during the 30 days before hospitalization. The frequencies of the other treatments during the 30 days before hospitalization differed only slightly. ICU patients presented a slightly lower rate of general practice consultations, but with similar intervals before hospitalization.

Patients who died in hospital were older, with more cardiovascular co-morbidities, including already known HF. They presented higher rates of general practice consultations and nursing care, but a lower rate of cardiology consultations. They presented lower frequencies of ACE

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inhibitor/ARB and beta-blocker therapy. By comparison, the frequency of diuretic therapy was higher, suggesting a higher rate of contraindications to the above-mentioned first-line treatments; however, this may also be explained by the lower rate of cardiology consultations. These findings are consistent with reports in the literature indicating that older patients with more co-morbidities are less frequently followed by a cardiologist, that patients followed by a cardiologist are more often treated with ACE inhibitors/ARBs and beta-blockers and that these treatments lower the mortality rate [19,23]. The 8% in-hospital mortality rate was slightly higher than the 6.4% in-hospital mortality rate observed for incident hospitalizations in France in 2009 [7], and higher than the 2.6% in-hospital mortality rate observed for prevalent hospitalizations of the American Heart Association's ''Get With the Guidelines-Heart Failure'' registry in 2010 [24].

Disparities in healthcare utilization

Marked geographical disparities were observed for the departmental rates of cardiology consultations, with 30-day consultation rates ranging from 3% to 46% (median 21%). This disparity may be related to departmental disparities in the density of cardiologists (3.5—26.3 per 100,000 inhabitants) (DRESS data for 2015 available at: http://www.data.drees.sante.gouv.fr) or variations in the intensity of outpatient-hospital coordination. However, it is possible that this coordination may be less effective in regions with a low density of healthcare professionals. For example, patients living in the center of France had lower rates of cardiology and general practice consultations, but higher rates of nursing care. We conducted a supplementary analysis (Table A.2) to search for significant correlations between caregiver density and their use by patients. General practitioner and cardiologist departmental densities were significantly correlated with general practitioner and cardiologist consultation percentages before and after hospitalization, and with a lower intensity with nurses. Departmental median intervals between the index hospitalization and the last or first consultation were significantly and negatively correlated for general practitioner and nurse departmental densities. This was not the case for cardiologists. Nevertheless, it must be noted that median interval for general practitioners was also negatively correlated with cardiologist and nurse densities. Globally, the departmental rate of cardiology consultations was inversely correlated with the rate of nursing care, which can be explained by density variations and replacement mechanisms. No departmental correlations were observed between readmission rates for HF and the rates or intervals between healthcare consultations.

Choice of population

The differences in terms of healthcare utilization observed according to the exclusion or inclusion of institutionalized patients were more marked for general practitioner consultations and nursing care, and were similar for cardiology consultations. Apart from the characteristics and specific co-morbidities that are more frequent among institutionalized patients, these differences could be explained by the global funding of skilled nursing homes, which includes nursing care but mostly no medical care [25,26]. Exclusion of institutionalized patients resulted in a loss of representativity and size of the population, but more accurate estimates of healthcare utilization rates. Indeed, their exclusion facilitated measurement of healthcare of patients with homogeneous exposure to outpatient care, and homogeneous modalities of management and reimbursement. Other solutions to the problem of immeasurable time bias can be used in analytical epidemiology (e.g. by adding the number of days of exposure to healthcare as a covariable to the model) [25,26]. The use of these methods in descriptive epidemiology, rather than the exclusion of institutionalized or deceased patients, would ensure better representativity of the population to estimate outpatient healthcare utilization. However, residents of skilled nursing homes constitute population groups with specific characteristics and a specific healthcare environment. It is therefore appropriate to study this population separately, and it could be useful to establish guidelines and target indicators specific to these populations.

Strengths and limitations

One of the strengths of this study was the large size of the study population, as general scheme and local mutualist section beneficiaries correspond to 75% of all patients hospitalized for HF in France. These beneficiaries may present specific characteristics, exposures and healthcare utilization compared with beneficiaries of the other schemes, as the various French health insurance schemes are based on occupation. Nevertheless, this study was a real-life observational study. A limitation common to all reimbursement database studies is underestimation of the number of admissions for HF [27]. However, ICD-10 codes are highly predictive of acute HF, with high positive and negative predictive values, good sensitivity and excellent specificity [28]. A French study comparing medical charts and computer files using the ICD-10 I.50 code showed that this code is able to accurately identify patients hospitalized for HF, especially when HF is the reason for admission. But this study confirmed that this code is unable to identify all patients with HF [29]. Another limitation of the SNDS, analysed in our study, concerns the diversity of modes of reimbursement and funding that may impact the comprehensiveness of funding data.

Conclusions

This study confirms that using the SNDS is a suitable approach to estimate healthcare utilization and compare this utilization with guidelines. However, in view of the diverse modalities of funding and reimbursement, patients must be included very cautiously, taking into account a possible selection phenomenon. The rates of recommended healthcare utilization that can be identified in the SNDS are not optimal and present geographical disparities. A higher rate of follow-up by cardiologists could improve compliance with recommended HF treatments.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version at: https://doi.org/10.1016/j.acvd.2019.11.011.

Disclosure of interest

The authors declare that they have no competing interest.

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