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Working paper

Does an Early Primary Care Follow-up after Discharge Reduce Readmissions for Heart Failure Patients?

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Does an Early Primary Care Follow-up after Discharge Reduce Readmissions after Heart Failure?

Damien Bricard[a], Zeynep Or[a]

Abstract: Better monitoring of patients in primary care setting is often considered to be a solution for reducing avoidable hospitalisations and readmissions. In this paper we test the hypothesis that the risk of readmission is associated with the timing and intensity of primary care follow-up, with a focus on consultations with a generalist (GP) after discharge by patients hospitalized for heart failure in France.

We propose a discrete-time model which takes into account that primary care treatments have a lagged and cumulative effect on readmission risk measured on a weekly basis, using an instrumental variable strategy (IV). The results from IV regressions suggest that a consultation with a GP in the first weeks after discharge can reduce the readmission risk by almost 50%, and that patients with higher ambulatory care utilisation have smaller odds of readmission. Furthermore, geographical disparities in primary care affect directly primary care utilization and hence indirectly the readmission risk.

These results suggest that interventions which strengthen communication between hospitals and generalists are elemental for reducing readmissions and improving system-wide cost efficiency. In order to encourage better care transition and to improve patient outcomes after discharge, financial incentives for hospitals should be aligned with the objective of avoiding repeated hospitalisations. However, the current hospital funding system in France, based on patient volumes, does not provide any incentive for investments to improve patient follow-up after discharge.

JEL codes: C22; I12; L24.

Keywords: Hospital, Readmission, Heart failure, Primary care, Health care organisation, Instrumental variable, Discrete-time model.

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Consulter rapidement un généraliste après une hospitalisation pour insuffisance cardiaque réduit-il le risque de réadmission ?

Damien Bricard[a], Zeynep Or[a]

Résumé : Un meilleur suivi des patients en soins primaires est souvent considéré comme une solution pour éviter les hospitalisations répétées et les réadmissions. Dans cet article, nous testons l'hypothèse selon laquelle le risque de réadmission est associé à la rapidité et à l'intensité du suivi en soins primaires, en mettant l'accent sur la consultation d'un généraliste, après une hospitalisation pour insuffisance cardiaque en France.

Nous proposons un modèle à temps discret qui permet de prendre en compte le fait que le suivi en soins primaires à un effet retardé et cumulatif sur le risque de réadmission, mesuré à la semaine, avec une méthode par variable instrumentale (IV). Les résultats de la régression IV suggèrent que le fait de consulter rapidement un généraliste dans les premières semaines après la sortie peut réduire le risque de réadmission de près de 50 % et que les patients utilisant plus de soins ambulatoires ont une plus faible probabilité de réadmission. De plus, les disparités géographiques dans l'accessibilité potentielle aux généralistes dans le lieu de résidence des patients affectent directement les recours et indirectement le risque de réadmission.

Ces résultats suggèrent que les interventions visant à renforcer la communication entre les hôpitaux et les généralistes sont essentielles pour réduire les réadmissions et améliorer l'efficience du système de santé. Afin d'encourager une meilleure coordination et améliorer les résultats des soins, les incitations financières des hôpitaux devraient coïncider avec l'objectif d'éviter les hospitalisations répétées. Pourtant, le financement hospitalier actuel en France ne donne pas d'incitation à investir dans le suivi des patients après leur sortie.

Codes JEL : C22 ; I12 ; L24.

Mots clés : Hôpital, Réadmission, Insuffisance cardiaque, Soins primaires, Organisation des soins, Variable instrumentale, Modèle à temps discret.

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1. Introduction

Reducing repeated hospitalisations of patients with chronic conditions is a policy objective for improving both the healthcare quality and system efficiency. In order to reduce readmission rates, hospitals are increasingly urged to invest in discharge management and better coordination of post-discharge care. Enhanced monitoring and follow-up of patients in primary care setting after discharge is considered to be the key for reducing avoidable hospitalisations and readmissions that are costly for the healthcare system (Desai and Stevenson, 2012; Pracht and Bass, 2011). In many countries there has been a shift in health policy towards reinforcing the role of primary care based on the hypothesis that there is a potential substitution between primary care and hospital use (Cohen, 1989; Fortney *et al.*, 2005).

In France, in the past couple of years, several initiatives have been focused on improving care coordination between hospital and ambulatory or primary care providers. For example, the pilot program (PRADO), initiated by the National Health Insurance Fund, aims to improve care transition from hospital to home by connecting patients with primary care professionals before they are discharged, in order to reduce the length of stay and readmissions for patients with chronic conditions such as heart failure and chronic obstructive pulmonary disease (COPD). The Ministry of Health has also launched in 2014 pilot programs (PAERPA) where primary care providers are given financial incentives to improve care coordination for the older patients with the objective of reducing avoidable hospitalizations and readmissions. In these initiatives, most of the attention and incentives are given to general practitioners (GP) who are considered as the key actors (HAS 2012; HAS 2014). For example, the PRADO program for heart failure patients endorses a customary GP visit during the first week after discharge in order to initiate and adapt the primary care treatments. However, currently very little is known in France as to the impact of primary care follow-up on hospital admissions. More generally, there is little quantitative evidence in literature concerning the impact of primary care interventions on readmission rates.

In this study, we test the hypothesis that the risk of readmission is associated with the timing and intensity of primary care follow-up, with a focus on GP consultation after discharge by patients who have been hospitalised for heart failure in France. Heart failure is a chronic condition where heart muscle is unable to pump enough blood through to meet the body's needs for oxygen (AHA, 2018). Not all situations that lead to heart failure can be reversed, but treatments and lifestyle changes (such as exercising, reducing salt in diet) can improve the symptoms. There are clear guidelines for managing heart failure in primary care settings (McMurray *et al.*, 2012, HAS, 2015) which are expected to reduce repeated hospitalisations. We concentrate on patients aged 65 years old or over which is the population concerned the most by this condition. Heart failure is a leading cause of hospitalization after 65 years old, and avoiding repeated hospital use for this condition is a major concern in France as in other countries (Bueno *et al.*, 2010; Ross *et al.*, 2009, Gabet *et al.*, 2015).

Empirical estimation of the impact of health treatments (physician follow-up) on readmissions with observational data raise two issues. The first problem is the dynamic nature of treatments over time, and the presence of censorship events. GP visits and/or any other primary care consumption is conditional on having or not previously one

of the following events: death, readmission to acute care or admission to another institution (rehabilitation or long-term care). To deal with censorship in data, most studies concentrate only on the effect of treatments during a limited period of time (a week or a month) on an outcome variable measured after this period and excluding the population who had any of the censorship events in the period. But this static approach limits the observation of the treatment to a single period, defined randomly, while treatments can change over time (days, weeks). Therefore, we use a discrete-time model (Allison, 1982; Jenkins, 1995) which allows to take into account that primary care treatments have a lagged and cumulative effect on readmission risk measured on a weekly basis.

The second issue is the selection bias which is a concern when using observational data, hence we cannot observe perfectly in our data health status of patients and their health preferences. The health and other characteristics of patients who obtained treatment (visited a GP) are likely to differ from those who did not (Newhouse and McClellan, 1998). Patients who have a more serious health condition are more likely to visit their GP after discharge, who in return can refer them back to hospital, and those who have no specific problem may not visit a physician quickly. Standard regression approach allow for adjusting for differences in observable variables but does not correct for unobserved factors. We propose an instrumental variable approach, exploiting the differences in GP density in patients' residence area, to account for omitted variables affecting both readmissions and primary care use.

The question we would like to answer is: do patients who visited a GP during the first weeks after discharge have lower risk of readmission in the month? We show, with IV regressions, that visiting a generalist reduces the readmission risk by about 50% and that local accessibility of generalists is significantly associated with GP visits and indirectly with 28-day readmission rates. Furthermore, hospital performance measured by 7-day readmission rates varies widely and impacts directly the risk of readmission. The rest of the paper is organised as follow. The next section summarizes the results from the literature looking at the determinants of readmission rates. Section 3 presents our empirical approach and the section 4 describes the data and variables used in the models. The descriptive statistics and results from the regressions are provided in section 5 followed by the conclusions.

2. Literature

Readmissions within a short time span after discharge are largely recognised as bad quality markers for hospitals (NQF, 2008; Axon and Williams 2011; Laudicella *et al.*, 2013; Papanicolas and McGuire, 2011). Hence 30-day readmission rates are increasingly considered as an indicator of hospital performance for adjusting hospital payments. In the United States, since 2012, Centres for Medicare and Medicaid services impose financial penalties for hospitals with excess 30-day readmission rates for patients with acute myocardial infection, heart failure and pneumonia, on the assumption that outcomes in this period are mainly influenced by hospitals (CMS, 2014; Bradley *et al,* 2013; Heidenreich *et al.*, 2012). The policy aims to improve the quality of inpatient treatments but also to incentivise hospitals to invest in coordination of post-discharge care.

There is a large amount of research looking at the patterns and determinants of readmission rates at the hospital level (Coyte *et al.*, 2000; Ho and Hamilton, 2000; Leppin *et al.*, 2014; Hansen *et al.*, 2011; Vest *et al.* 2010). Some studies are interested in hospital interventions which help to reduce readmissions, and suggest that beyond the quality of clinical treatment, patient education in hospital, medication reconciliation and the organisation of discharge have a direct impact on readmission rates (Avaldi *et al.*, 2015; Bradley *et al.*, 2013; Joynt and Jha, 2011; Krumholz *et al.*, 1997). Improving the transition from hospital to home and better patient follow-up during the first weeks after discharge appear to be essential for reducing readmissions shortly after discharge (Peikes *et al,* 2009; Gonseth *et al.*, 2004; Holland *et al.*, 2005; McAlister *et al.*, 2004; Phillips *et al.*, 2004).

A few studies have looked at the impact of primary care interventions on readmissions. In the United States, Lorch *et al.* (2010) show that variations in readmission rates across hospitals is partly linked to the quality of outpatient care facilities. But the evidence on the impact of different outpatient services such as GP follow-up on readmission risk is mixed (Murtaugh *et al.* 2017, Rogers *et al.*, 2007; Feltner *et al.*, 2014). A few studies from the US and Canada showed that 30-day readmission rates are lower in hospitals where patients have an early physician visit (Hernandez *et al.*, 2010), and regular follow-up with a family physician can reduce death and readmissions at 6 months (McAlister, 2013). These studies based on observational data do not control for the potential confounding factors linked to unmeasured patient characteristics, so it is difficult to conclude on the causality and the strategies to reduce readmissions. Recently, Murtaugh *et al.* (2017), used an extension of an instrumental variable model to correct for selection effect, in order to compare the effectiveness of two interventions in the US: intensive home health nursing and physician follow-up within a week. They suggest that none of these interventions have an impact alone, while their combination can reduce 30-days readmission risk. Overall, the evidence on the effectiveness of primary care providers to reduce hospital utilisation remains weak.

To our knowledge, there is no study in France looking into the determinants of readmissions. Readmission rates are not followed regularly and not used as a hospital performance measure. Tuppin *et al.* (2013, 2014) following a cohort of patients hospitalized in 2009 for heart failure showed that readmission rates were high: 45% at one year for HF readmissions and 73% when all-cause readmissions are counted, and that there is room for improvement by reinforcing follow-up drug treatments and discharge management of patients. However this descriptive study does not look into the links between hospital and other healthcare factors and readmission risk.

3. Empirical approach

The outcome variable we are interested in is the readmission risk within 28 days (four weeks) after discharge. Our main regressions aim to estimate the impact of primary care treatments over this period on the readmission risks.

The first difficulty for the estimations is that patient treatments are not fixed in time but evolve over time depending partly on the occurrence or not of a number of censorship events, including a readmission to hospital but also death or admission to another institution over the period. To measure the impact of the treatments provided in the

month after discharge in a homogeneous way, we need to define a fixed time period in which none of the censorship events has arrived. In literature, most studies concentrate only on the treatments provided in the first week (Murtaugh *et al.*, 2017) or in the first month (Ezekowitz *et al.*, 2005; McAlister, 2013) after discharge excluding all the population concerned with any of the censorship events. In this study, we use instead a discrete time model (Allison, 1982; Jenkins, 1995) where both the risk of readmission and primary care treatment (GP visit) are measured on a weekly basis. This allows us to quantify the primary care use for each patient on the same unit of time (week) and to cumulate primary care utilisation from discharge to the week at risk before a censorship event. In this way, we also take into account that primary care treatments have a lagged and cumulative effect on readmission risk measured on a weekly basis.

The probability of readmission for the individual i during week t (R_{it}) is determined by his/her health status before and during the hospitalisation, other control variables (X_i) and the primary care treatments/GP follow-up cumulated in the weeks after hospital discharge (F_{it-1}), and conditional on the occurrence (absence) of censoring events (readmission, death or admission to another setting) in the previous week:

$$R_{it} = a.X_i + \beta.F_{it-1} + u_{it} \quad (Eq.1)$$

With = 1, …, n ; t = 2,3,4 $R_{it-1} \neq 1$ or any censorship event the previous week.

This model takes into account the dynamic relationship between primary care and readmission risk but could suffer from omitted variable bias. Patients who visit a generalist in a short time span (within a week or two) after discharge may have different health characteristics (unobserved) which can bias the estimation of the impact of primary care utilisation (treatment) if $corr\ (F_{it-1}, u_{it}) \neq 0$. This would be the case of sicker individuals who have a higher risk of readmission who consulted a GP more quickly after discharge. It could be also the case of patients whose health preferences lead both to an early GP contact and a readmission. To avoid this bias, we propose an instrumental variable strategy which relies on the assumption that an exogenous variable Z_i has an indirect effect on R_{it} through F_{it-1}.

For this, we exploit differences in primary care supply across patients' residence areas, using the indicator of potential local accessibility (PLA) of generalists, as the instrument. The PLA is an indicator of the local availability/density of generalists in patients' residence area and calculated by taking into account both the density (full time equivalent GPs), their geographic distribution and the demographic characteristics (age structure) of the population served. A good instrument should affect the treatment variable that of interest (here GP/primary care visits), but should have no direct impact on outcome measure. We assume that PLA is a good exogenous predictor of GP utilisation, independent of patients' health status. We further assume that PLA of generalists does not have a direct impact on readmission risk, but only an indirect impact through GP treatment/follow up. The density and/or distance of healthcare supply has already been proposed in the literature as an exogenous variable for estimating the treatment effect (Chandra and Staiger, 2007; Cutler, 2007; Stukel *et al.*, 2007; McClellan *et al.*, 1994).

With this, we estimate the following model of primary care utilisation (F_{it-1}) as a function of individual control/ health characteristics (X_i) and the instrumental variable (Z_i):

$$F_{it\text{-}1} = \gamma.\ X_i + \delta.Z_i + e_{it-1} \quad (Eq.2).$$

Where, Z_i corresponds to the GP availability (PLA) in the residence area of individual i. We use the same individual control (X_i) in equation 1 and equation 2.

By substituting equation (2) into equation (1) we obtain the following IV discrete-time model:

$$R_{it} = a.X_i + \beta.\hat{F}_{it-1} + u_{it} \quad (Eq.3)$$

We estimate this model using a discrete-time logistic regression with heteroscedasticity adjustment on individual clusters and a two stage instrumental methods. The use of instrumental variable method allows to verify the correlation between e_{it} and u_{it} using the Wald test of exogeneity from maximum likelihood estimations.

4. Data and variables

4.1. Dataset and sample selection criteria

The analysis is based on linked claims data for patients 65 years or over who have been admitted to hospital for heart failure between February 1rst and November 30th from 12 regions of France (67% of the population in metropolitan France). The ambulatory claims dataset from the National health insurance fund provides exhaustive patient level data for all physician and nursing services, and other ambulatory consumptions and their prices. The National hospital discharge database (PMSI) cover all inpatient admissions, outpatient consultations, and provides detailed patient diagnoses, etc. We use an extract of this dataset including patients 65 years old or over hospitalized in 2013 with heart failure (HF) as principal or associated diagnosis[1]. The data on healthcare supply in patients' residence area (used as instrument) come from a database managed by the research department of the Ministry of Health (DREES, *Direction de la recherche, des études, de l'évaluation et des statistiques*).

The initial sample consisted of 90,191 patients. We excluded patients hospitalized during January and December to follow each cohort over a complete month before and after the first discharge (exclusion of 14,622 patients). Patients with a missing information concerning the area of residence were also excluded from the analysis (2,205 patients). In order to have a more homogeneous group of patients, we also omitted patients with a known historic of health failure. We excluded patients hospitalized in 2012 for a heart failure and/or those diagnosed as having a chronic heart failure problem by an ambulatory physician, with an ALD status (exclusion of 31,383 individuals). In this way we focus on patients who are recently diagnosed with heart failure in hospital in 2013 and on their initial care pathways after discharge.

[1] Principal diagnosis (PD) of heart failure (HF) in ICD-10 code I50, as well as an associated or related diagnosis in I50 and a PD in I11.0 (hypertensive heart disease), I13.0 (hypertensive and renal disease with (congestive) heart failure), I13.2 (hypertensive heart and renal disease with (congestive) heart failure and renal failure), I13.9 (hypertensive heart and renal disease, unspecified) or K76.1 (chronic passive congestion of liver) or J81 (pulmonary oedema).

Finally, the analysis is restricted to the population discharged home after the first/index hospitalisation. Patients discharged to long-term care institutions, rehabilitations facilities, psychiatric hospitals and home hospital were excluded, as well as those deceased during the hospitalisation. Table 1 gives the distribution of HF patients by their discharge site. About 9% of the patients hospitalised for heart failure died in hospitals and 14% are discharged into a rehabilitation facility. Our final sample comprises 28,848 patients 65 years old and over who returned home after discharge (70.5% of the initial sample).

The dataset we used does not contain the exact date of death of patients deceased at home, because of the data confidentiality issues. Instead, we have information on the quarter of death of these patients. Therefore, we checked the robustness of our results using two samples: a sample including all patients and a sample excluding all patients deceased during the quarter of hospitalization.

Table 1 **Patients hospitalized for heart failure in 2013, by site of discharge**

	Freq.	%
Post-discharge site		
Home	28,848	70.5
Nursing homes	1,473	3.6
Rehabilitation facilities	5,838	14.3
Long-term acute care	296	0.7
Psychatric hospital	61	0.1
Hospital at home	226	0.6
Other hospital transfers	331	0.8
Death	3,841	9.4
Total	**40,914**	**100**

Sources: Sniiram (DCIR), PMSI MC 2013, Drees 2013.

4.2. Variables

4.2.1. Outcome variable: Readmission risk

We measure readmissions for all cause of hospitalization after a first (index) hospitalization for heart failure. We use this information to construct a person-week database and create a dummy variable indicating the week of readmission. In the analysis, we include each week, all the patients who are still at risk of readmission (see Table A1 in Appendix). Readmissions during the first week are excluded in the model, hence we are exploring a dynamic (or lagged) relationship between ambulatory treatment and readmission risk. The treatments in the first week will affect the readmission risk in week 2, 3 and 4, and the treatments in week 1 and 2 the risk in week 3 and 4, and so on. Therefore, we do not estimate the determinants of readmission in the first week after discharge, but use the information concerning the risk of readmission during the first week to calculate a hospital readmission score (see below) which is used as an explanatory variable in the model.

4.2.2. Primary care treatments

Concerning primary care utilization, we are primarily interested in the first GP contact after discharge. We first track the time (week) of the first contact with a GP and estimate the impact of the first GP contact (by week) on readmission risk. We also studied the patterns of any physician contact (GP or specialist) as some patients may prefer to see a cardiologist or another specialist first, to see if there is any difference in the results. Finally, we checked if the intensity of treatments provided in the ambulatory setting (proxied by the ambulatory care expenditure) have an impact on readmission risk. The treatments and prescriptions provided by the GP, specialists and nurses may substitute hospital care. Hence, we constructed an indicator which gives the average of cumulative ambulatory expenditure by week. The results from these sensitivity analysis are presented in the Appendix.

4.2.3. Instrument: Potential Local Accessibility of GPs

In order to account for omitted variables affecting both the risk of readmission and primary care use, we use the Potential Local Accessibility (PLA) as instrument. A reliable instrument should be correlated with the primary care utilisation/treatment (first contact with a GP and ambulatory care expenditure) but must not affect directly the risk of readmission.

The PLA for GPs is an indicator of accessibility of generalists at the patients' residence area. Calculated at the Zip code area level, the index weights the density of generalists, measured as full time equivalent (FTE) per capita, in patient's residence area as a function of average distance run by patients to see a GP and the age structure of the population served (Barlet *et al.*, 2012; Lucas-Gabrielli and Nestrigue, 2016). Hence, the indicator allows to measure the ease of access to GPs by taking into account the geographic distribution of generalists and the local demand (age). All else being equal, the further the distances run, and the older the population in an area is the lower the accessibility. We consider that the accessibility of GPs is a good proxy of local primary care resources available to patients. The APL of GP would be correlated with other primary care resources in particular with ambulatory nurses. This does not violate the assumption that the impact of the IV is through its impact on exposure to treatment, but means that GP consultation (treatment) can reflect the effect of a wider primary care interventions which may or not be prescribed by the GPs.

4.2.4. Individual controls

Patients' readmission risk will be mostly linked to their health status. We adjust for individuals' clinical and demographic characteristics at the time of the hospitalization for HF, by controlling for gender, age (in six categories), length of index stay in hospital (in five categories) and the Charlson index (Charlson *et al.*, 1987; Quan *et al.*, 2005) as an indicator of patient co-morbidity. The index is constructed from a list of 17 significant comorbidities. We defined a categorical variable with four modalities: 0, 1-2, 3-4 and 5 and more Charlson co-morbidities.

We further control for the healthcare utilization (number of GP visits and ambulatory care expenditure) during the month before the hospitalization for each patient, since this may be an indication of the health status and health preferences of patients.

Ambulatory expenditure covers the cost of all of the drugs, GP and specialists visits, nurses and physiotherapists, medical equipment and lab tests, etc. We expect that patients who were high ambulatory care users before hospitalization to have a higher propensity to have a readmission.

We also control for the distance to the nearest emergency unit in patients' residence area, in order to account for the potential substitution between visits to hospital emergency services and primary care providers. Previous studies in France have shown that there is a strong correlation between the distance to emergency services and the rates of emergency visits in an area: shorter the distance higher the probability to visit an emergency department (Or and Penneau, 2017).

Finally, we use the information on readmission rates during the first week to calculate a hospital level indicator of quality. The 7-day readmission rates may be more closely related to hospitals' treatment patterns and discharge quality, and patients hospitalized in high-rate facilities may have higher propensity to readmit in the month.

5. Results

5.1. Descriptive statistics

5.1.1. Patterns of primary care use and readmission risk

In 2013, among the 28,848 patients aged 65 or over who are discharged at home, the readmission rate after 28 days was 24% (Table 2). The readmission risk was the highest in the second week, increasing slightly from 6.2% in the first week to 6.6%, before decreasing over weeks to around 5% in the fourth week.

During the first week after discharge, 42% of HF patients had a contact with a GP. The rate of patients who visited a GP reaches to 77% at the end of the fourth week (Table 2). The patterns of visits to any doctor (GP or specialist) are quite similar and show that 5.6 % of the patients visit a specialist during the first week (instead of a GP). Ambulatory care expenditures are significantly higher in the first week after discharge while it remains quite stable in the following weeks (see Figure A1 for the evolution of ambulatory care utilisation over weeks).

Table 2 Primary care use and readmission risks: heart failure patients discharged home

	Readmission risk		First GP visit		First physician visit		Ambulatory care expenditure		Patients at risk
	%	Cum. %	%	Cum. %	%	Cum. %	Mean	Cum. Mean	Obs.
Week									
1	6.2	6.2	42.1	42.1	47.7	47.7	340.1	340.1	28,848
2	6.6	12.8	17.6	59.5	19.9	67.4	160.8	247.7	26,703
3	5.9	18.6	10.5	69.5	10.9	77.8	162.0	215.1	24,729
4	5.3	23.9	8.2	77.4	7.8	85.2	176.9	202.6	23,131

Sources: Sniiram (DCIR), PMSI MC 2013..

5.1.2. Selection bias

Table 3 provides descriptive statistics for patients discharged at home, according to their status of GP visit in the first week. As expected, individuals who visited a GP during the first week differ in terms of demographic and clinical characteristics. They are older, and they have a slightly longer length of stay than those with no GP visit during the first week. They also differ in terms of the intensity of ambulatory care utilisation during the month before the hospitalisation, with a higher ambulatory care expenditure and higher number of GP visits. Not surprisingly, ambulatory expenditure is higher for those who had a GP visit in the first week after discharge with an average of 416 euros against 285 euros in average for those who did not. The difference between the two groups becomes smaller in the following weeks.

Table 3 Characteristics of elderly patients (65+) discharged home after a first hospitalization for heart failure in 2013

		All patients discharged home		GP contact the first week after discharge: No		GP contact the first week after discharge: Yes	
		(n=28,848)		*(n=16,700)*		*(n=12,148)*	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Demographic and clinical variables							
Age		81.4	8.0	80.9	8.1	82.1	7.8
Female		50.9%	50.0%	49.4%	50.0%	53.1%	49.9%
Length of stay		9.4	7.1	9.2	7.1	9.6	7.0
Charlson index		1.6	1.7	1.6	1.7	1.6	1.7
Primary care use (month before hospitalization for HF)							
Number of GP visits		1.4	1.4	1.1	1.2	1.8	1.5
Monthly expenditure		641.2	796.5	603.0	822.3	693.7	756.6
Contextual variables							
PLA of GP		67.9	26.7	65.4	26.1	71.5	27.1
Distance to nearest emergency unit (minutes)		10.1	9.9	9.9	10.0	10.3	9.8
Hospital performance (readmission score)		6.2%	4.4%	6.2%	4.5%	6.2%	4.3%
Primary care use (after discharge)							
Weekly expenditures	Week 1	340.1	387.0	285.0	369.2	415.9	398.0
	Week 2	160.8	266.5	145.4	263.3	182.1	269.4
	Week 3	162.1	277.2	147.1	290.7	183.2	255.5
	Week 4	176.9	278.9	162.6	279.2	197.2	277.3
Mean cumulative weekly expenditures	Week 1	340.1	387.0	285.0	369.2	415.9	398.0
	Week 2	247.7	263.6	213.2	250.9	295.5	273.1
	Week 3	215.2	220.7	187.9	213.5	253.7	225.0
	Week 4	202.6	201.7	178.7	196.2	236.5	204.5
Readmission risk	Week 1	6.2%	24.1%	6.0%	23.7%	6.5%	24.7%
	Week 2	6.6%	24.9%	6.0%	23.8%	7.4%	26.2%
	Week 3	5.9%	23.5%	5.9%	23.5%	5.8%	23.4%
	Week 4	5.2%	22.3%	5.1%	22.1%	5.4%	22.6%

Sources: Sniiram (DCIR), PMSI MC 2013, Drees 2013.

Table 4 Discrete time regression results of the effect of GP follow-up on readmission risk

	Readmission risk - Logistic regression						GP follow-up		
	Initial model (*Eq.* 1)			IV model (*Eq.* 3)			First step (*Eq.* 2)		
	Odds Ratio	P>z	Std. Err.	Odds Ratio	P>z	Std. Err.	Coef.	P>t	Std. Err.
Week ***(Ref.: Week 2)***									
Week 3	0,86	***	0,03	0,98		0,07	0,17	***	0,00
Week 4	0,75	***	0,03	0,94		0,09	0,27	***	0,00
Sex ***(Ref.: Men)***									
Women	0,85	***	0,03	0,86	***	0,03	0,01	***	0,01
Age ***(Ref.: [65-70[ )***									
[70-75[	1,03		0,07	1,04		0,07	0,01		0,01
[75-80[	0,92		0,05	0,95		0,06	0,04	***	0,01
[80-85[	0,90	*	0,05	0,94		0,06	0,05	***	0,01
[85-90[	0,81	***	0,05	0,85	***	0,05	0,06	***	0,01
>90	0,75	***	0,05	0,78	***	0,05	0,05	***	0,01
Length of stay ***(Ref.: [0-4] days)***									
[5-7]	1,15	***	0,06	1,16	***	0,06	0,01		0,01
[8-10]	1,18	***	0,06	1,21	***	0,06	0,03	***	0,01
[11-15]	1,32	***	0,07	1,36	***	0,07	0,03	***	0,01
>15	1,41	***	0,08	1,46	***	0,08	0,04	***	0,01
Charlson index ***(Ref.: 0)***									
[1-2]	1,01		0,04	1,00		0,04	-0,01		0,01
[3-4]	1,17	***	0,06	1,16	***	0,05	-0,01		0,01
>5	1,36	***	0,09	1,36	***	0,09	0,00		0,01
Nb. of GP consultations (in the month before)	1,02	*	0,01	1,10	***	0,03	0,08	***	0,00
Distance to the nearest emergency unit ***(Ref.: 0 min.)***									
1 to 14 minutes	1,02		0,04	1,05		0,04	0,07	***	0,01
15 to 24 minutes	1,05		0,05	1,07		0,05	0,04	***	0,01
25 to 39 minutes	1,05		0,06	1,07		0,06	0,04	***	0,01
> 40 minutes	1,28		0,24	1,35		0,26	0,08	**	0,03
Hospital performance (readmission score)	2,61	***	1,01	2,45	**	0,94	-0,04		0,07
GP follow-up	1,23	***	0,04	0,51	**	0,17			
PLA of GP ***(Ref.: Quintile 1)***									
Quintile 2							0,02	**	0,01
Quintile 3							0,04	***	0,01
Quintile 4							0,08	***	0,01
Quintile 5							0,14	***	0,01
Number of observations (patient weeks)		73 363			73 363			73 363	
Number of patients		26 277			26 277			26 277	
Wald test of exogeneity (chi2)				7,03	***				

Regressions with cluster robust corrected standard errors. P-value: *** p≤0.01; ** p≤0.05; * p≤0.1.

Sources: Sniiram (DCIR), PMSI MC 2013, Drees 2013.

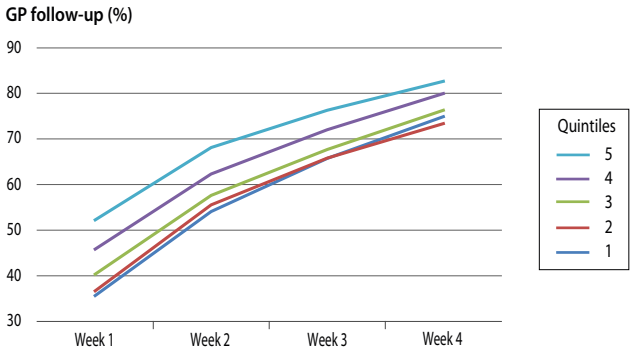
Globally, results of this descriptive table suggest that there is a risk of selection bias, linked to unobserved health characteristics of the patients who visit a GP rapidly.

5.1.3. Variations in GP visits over weeks according to PLA

Figure 1 presents the variations in the first GP contact by quintile of PLA. It shows that 36% of the patients living in the first quintile of PLA (lowest GP access) had a first GP contact during the first week against 52% of those living in the fifth quintile (where the number of GPs per capita is higher and the distances are lower). We see that differences between residence areas decrease over time but are persistent (75% versus 83% at week 4).

Therefore, we suppose that part of the differences in the early access to a GP is due to the differences in local availability of generalists which is not correlated with observed variables of patients' health status (see Table A2 in appendix for the distribution of patient variables by quintile of PLA of GPs). The last column of Table A2 shows that there is no correlation between PLA and Charlson index or other control variables, despite a small significant correlation with LOS (-0.033) and with age (0.026).

Figure 1 GP follow-up over weeks after discharge for HF according to quintile of PLA*



* Potential local accessibility of GP.
Sources: Sniiram (DCIR), PMSI MC 2013, Drees 2013.

5.2. Regression results

Table 4 presents the results from the discrete time logistic regressions concerning the weekly readmission risk. The first column presents the results from model 1 (*Eq.* 1) logistic regression without correcting the endogeneity of treatments (to readmissions), while the second gives the IV models which correct for the selection bias (*Eq.* 3). The last column shows the results of the first stage regression estimating the propensity of visiting a GP over weeks as a function of observable patient characteristics and the PLA (*cf. Eq.*2). The results of the first model (column 1) suggest that patients visited a GP during the first week have a higher risk of readmission (OR of 1.23 and 95% CI [1.15; 1.32]) even after controlling for observed health characteristics (age, comorbidity, LOS in hospital, care utilisation in the month before admission). The results also show that women and the oldest patients, over 80 years old, have a lower risk of readmission

compared with those 65 to 80 years old. The readmission risk goes up for patients who had a longer length of stay and a high co-morbidity index in hospital. The number of GP contacts in the month before admission, which could be an indicator of poor health status (unobserved health effect) has a positive association with the readmission risks. As expected, our hospital performance indicator, the hospital readmission score constructed from 7-day readmission rates for each hospital, is highly significant and shows that patients hospitalized in high rate facilities have higher propensity to have a readmission in the month. This suggest that, all else being equal, hospital characteristics, including their discharge policies, can vary widely and impact significantly the risk of readmission of patients.

From the results above, if we ignore the issue of endogeneity, we could conclude that early GP visits do not reduce the risk of hospital readmission, but on the contrary increases the propensity to readmit. This may be a plausible result given that, especially in France, GP's capacity to prevent readmissions is limited and depend on the efficacy of information transferred from hospitals and on the options (resources) available to refer patients. However, the estimations from the Instrumental variables (IV) model based on a Wald test of exogeneity of GP visits confirm that endogeneity is a problem (p-value 0.008). The results of the IV model (column 2 in Table 3), correcting for selection bias, suggest that the impact of GP visits on the readmission risks is significantly negative (OR of 0.51 and 95% CI [0.27; 0.98]): all else being equal, the odds of readmission reduces by 50% for patients visited a GP during the first three weeks after discharge.

The results from the first stage estimations (column 3) are also of interest as they attest large differences in GP visits as a function of GP availability in patient's residence area (instrumental variable PLA), once observable health characteristics are controlled for. Results also show that propensity to visit a GP in the first weeks after discharge is higher for older patients, for those who have longer length of stay in hospital and those with a higher number of physician contacts in the month before hospitalization. This could be a sign of poorer health status but also different habits or preferences in terms of health care use between individuals. Lastly, we note that patients living closer to an emergency unit have a lower propensity of visiting GP, which suggest that there is a substitution between emergency room utilization and GP follow-up.

5.3. Robustness checks

We also estimated the regressions by using visits to any physician in the first weeks after discharge and the logarithm of total ambulatory care expenditure per week as treatment variable (Appendix Table A3). These results largely confirm the main conclusions from the Table 4 and give some further insights.

About 5.6% percent of patients visit a specialist within the first week after discharge instead of a GP and in total about 8% have visited only a specialist within the month (Table 2)[2]. The results in Table A3 (the coefficient of physician contact) suggest that the ambulatory care follow-up by specialists can substitute GP visits in the short term or can be complementary to GP follow-up in the weeks after discharge helping to reduce

[2] In France, patients are encouraged, *via* financial incentives, to have a "preferred doctor" as their gatekeeper to the system (Dourgnon and Naiditch, 2010). While most patients declare a GP, they can also choose a specialist as their preferred doctor.

readmission risk. Again from Table A3, we confirm that the risk of readmission goes down significantly with the level of ambulatory care expenditure in the weeks after discharge with an OR of 0.31 and 95% CI [0.09; 1.08] (column 2) once we corrected for the endogeneity.

We further tested the robustness of our results by estimating the models using a different sample by excluding patients who deceased during the quarter of hospitalization since the dataset we used does not contain the exact date of death of patients who deceased at home. These results are also presented in the Table A3 and show that our results are stable when the sample is constraint only to survivors.

Finally, we tested the sensitivity of the estimations to other specifications of the instrumental variable (linear and quadratic form) which does not affect the results (tables are available from the authors).

5.4. Caveats

We should note that the use of IV estimation may not solve all the problems of endogeneity. Problems could arise if there are unobserved instrument-outcome confounders. In the equations, we controlled for the distance to emergency unit to adjust for any potential correlation between these variables, or substitution effect between GP and emergency use. In our sensitivity analyses we also controlled for a number of other confounders such as the median income in the patient's residence area and being resident in a rural zone. The first variable was not correlated with readmission risk and the second one was correlated with the instrument as well as the outcome. We did not include these variables in the final models, as they did not affect the results or added any further useful information. Second, we should note that our measure of "ambulatory care intensity" is not perfect. In the database, we cannot track nursing care provided by some structures at home nor social services. We only have information on the utilization of private nurses paid by FFS. Therefore, we risk to underestimate the intensity of care utilization for some patients.

6. Conclusions

We analysed in this paper the impact of early primary care treatments after hospital discharge on the readmissions of older patients with heart failure (HF) condition. The analysis is focused on the risk of readmission within the first month after discharge with the hypothesis that this period is particularly critical for understanding the issues around the transition from hospital to home and for assessing the differences in patient follow-up (Desai and Stevenson, 2012).

In France, like many other countries, the role of general practitioners in coordinating care for their patients is seen as essential for improving the treatment of chronic problems and reducing the risk of hospitalisations. There are clear recommendations about visiting a GP within the week after discharge for HF patients. But, it is difficult to establish the true impact of GP visits on patient outcomes because of the unobserved patient characteristics that impact both primary care utilisation and the outcome of interest (readmissions).

We proposed a discrete time model with an instrumental variable (IV) estimation to overcome the selection bias due to unobserved patient characteristics. We showed that standard regression approach adjusting only for observable health variables can be misleading. Patients' health status and previous consumption patterns, or preferences for seeking care, are correlated with both GP visits and readmissions to hospital. We further confirmed that GP density/accessibility in patient's residence area is a valid instrument because it is a strong predictor of GP utilisation but not correlated with the health status of the patients in an area.

The results from our IV model suggest that a rapid consultation with a GP in the first weeks after discharge can reduce the readmission risk by almost 50%, and that patients with higher ambulatory care utilisation have smaller odds of readmission. An early consultation may correspond to a series of ambulatory treatments that are initiated and coordinated by the GP. The GP can adapt the drug treatments, help patient education, etc. but can also refer the patient to a specialist (cardiologist, geriatrician, etc.) and/or other primary care professionals (nurse, dietician, physiotherapist) if necessary. Globally our results confirm that there may be a trade-off between care consumption in the ambulatory setting and need for hospital use. Furthermore, there are significant differences in hospital performance in tackling readmissions, and the geographical disparities in primary care resources where patients live affect directly primary care utilization and hence indirectly the readmission risk.

These results have several policy implications. First, globally, ensuring a rapid primary care follow-up after discharge appear to be an effective lever for reducing repeated hospitalizations of patients with chronic health conditions. Interventions which strengthen care transition, in particular communication between hospitals and primary care providers, are essential for improving system-wide cost-efficiency. But for developing effective strategies at hospital level, it is also necessary to recognize the role of the primary care resources that are available to patients in their residence area.

At the same time, hospitals have the key role in assuring an appropriate post-discharge care for patients with chronic health problems and in reducing readmissions. Differences in readmission rates may reflect the differences in discharge planning at hospital and practical information transfer to ambulatory care providers. In order to encourage better care transition and to improve patient outcomes after discharge, financial incentives for hospitals should be aligned with the objective of avoiding repeated hospitalisations. However, the current hospital funding system in France, based on patient volumes, does not provide any incentive for investments to improve patient follow-up after discharge and prevent repeated admissions. Our results call for measures encouraging hospitals to improve coordination with primary care providers, and follow-up after discharge for improving outcomes for chronically-ill patients.

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8. Appendix

Table A1 Patient sample over weeks, excluding individuals with concurrent events

	Patients at risk of readmission and concurrent events			
	Week 1	Week 2	Week 3	Week 4
At risk of readmission at the begining of the week	28,848	26,703	24,729	23,131
Patients with readmission	1,791 *6.2%*	1,770 *6.6%*	1,449 *5.9%*	1,214 *5.3%*
Patients with concurrent events (admitted to another institution* or died**)	354 *1.2%*	204 *0.8%*	149 *0.6%*	103 *0.5%*

* Rehabilitation centers, home hospitalization or psychiatric care institutions.

** Patients died in hospital or another institution.

Sources: Sniiram (DCIR), PMSI MC 2013.

Table A2 Patients characteristics according to the quintile of PLA (GP availability)

	Q1 (m=31.8)	Q2 (m=53.8)	Q3 (m=67.4)	Q4 (m=82.1)	Q5 (m=105.5)	Spearman's rho
Demographic and clinical variables						
Age	81.2	81.1	81.2	81.7	81.6	0.026
Female	47%	51%	51%	53%	53%	0.037
Length of stay	9.6	9.5	9.4	9	9.2	-0.033
Charlson index	1.5	1.6	1.6	1.5	1.6	0.007
Primary care use (the month before admission)						
Number of GP contacts	1.3	1.3	1.4	1.5	1.6	0.087
Ambulatory care expenditures	632	640.6	639.8	636.3	657.3	0.026
Contextual variable						
Distance to the nearest emergency unit	15.7	8.7	8.8	7.9	9.4	-0.218

Sources: Sniiram (DCIR), PMSI MC 2013, Drees 2013.

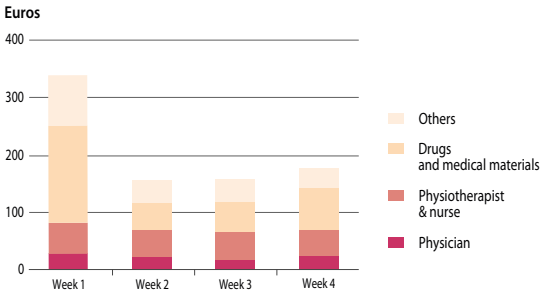
Table A3 Robustness checks of the impact of doctor follow-up on readmission risk

	Model without IV			Model with IV		
Dependant variable	OR	P-value	Std. Err.	OR	P-value	Std. Err.
Follow-up by a GP						
All patients	1,23	***	0,04	0,51	**	0,17
Without patients dead during the quarter	1,22	***	0,05	0,52	*	0,18
Follow-up by a doctor (GP or specialist)						
All patients	1,42	***	0,06	0,38	**	0,18
Without patients dead during the quarter	1,46	***	0,06	0,39	*	0,19
Log of ambulatory care expenditure						
All patients	1,27	***	0,03	0,31	*	0,20
Without patients dead during the quarter	1,26	***	0,03	0,31	*	0,22

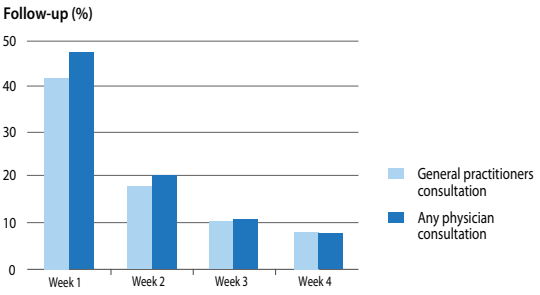
Sources: Sniiram (DCIR), PMSI MC 2013.

Figure A1 First contact with a GP and evolution of ambulatory care expenditure by week

a. Ambulatory care expenditure after discharge



b. First consultation with a GP or any physician after discharge



Sources: Sniiram (DCIR), PMSI MC 2013, Drees 2013.

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Does an Early Primary Care Follow-up after Discharge Reduce Readmissions for Heart Failure Patients?

Consulter rapidement un généraliste après une hospitalisation pour insuffisance cardiaque réduit-il le risque de réadmission ?

Damien Bricard, Zeynep Or (Irdes)

Better monitoring of patients in primary care setting is often considered to be a solution for reducing avoidable hospitalisations and readmissions. In this paper we test the hypothesis that the risk of readmission is associated with the timing and intensity of primary care follow-up, with a focus on consultations with a generalist (GP) after discharge by patients hospitalized for heart failure in France.

We propose a discrete-time model which takes into account that primary care treatments have a lagged and cumulative effect on readmission risk measured on a weekly basis, using an instrumental variable strategy (IV). The results from IV regressions suggest that a consultation with a GP in the first weeks after discharge can reduce the readmission risk by almost 50%, and that patients with higher ambulatory care utilisation have smaller odds of readmission. Furthermore, geographical disparities in primary care affect directly primary care utilization and hence indirectly the readmission risk.

These results suggest that interventions which strengthen communication between hospitals and generalists are elemental for reducing readmissions and improving system-wide cost efficiency. In order to encourage better care transition and to improve patient outcomes after discharge, financial incentives for hospitals should be aligned with the objective of avoiding repeated hospitalisations. However, the current hospital funding system in France, based on patient volumes, does not provide any incentive for investments to improve patient follow-up after discharge.

* * *

Un meilleur suivi des patients en soins primaires est souvent considéré comme une solution pour éviter les hospitalisations répétées et les réadmissions. Dans cet article, nous testons l'hypothèse selon laquelle le risque de réadmission est associé à la rapidité et à l'intensité du suivi en soins primaires, en mettant l'accent sur la consultation d'un généraliste, après une hospitalisation pour insuffisance cardiaque en France.

Nous proposons un modèle à temps discret qui permet de prendre en compte le fait que le suivi en soins primaires à un effet retardé et cumulatif sur le risque de réadmission, mesuré à la semaine, avec une méthode par variable instrumentale (IV). Les résultats de la régression IV suggèrent qu'une consultation rapide avec un généraliste dans les premières semaines après la sortie peut réduire le risque de réadmission de près de 50 % et que les patients utilisant plus de soins ambulatoires ont une plus faible probabilité de réadmission. De plus, les disparités géographiques dans l'accessibilité potentielle aux généralistes dans le lieu de résidence des patients affectent directement les recours et indirectement le risque de réadmission.

Ces résultats suggèrent que les interventions visant à renforcer la communication entre les hôpitaux et les généralistes sont essentielles pour réduire les réadmissions et améliorer l'efficience du système de santé. Afin d'encourager une meilleure coordination des soins et améliorer les résultats des soins, les incitations financières des hôpitaux devraient coïncider avec l'objectif d'éviter les hospitalisations répétées. Pourtant, le financement hospitalier actuel en France ne donne pas d'incitation à investir dans le suivi des patients après leur sortie.

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