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**TITRE DE LA THÈSE :**

**A personalized algorithm-based discharge checklist in  
patients with acute heart failure.**

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## **Abbreviations**

**ACEI** : angiotensin-converting enzyme inhibitors

**ARB** : angiotensin receptor blockers

**ARNI** : angiotensin receptor-neprilysin inhibitor

**CL** : checklist

**HF** : heart failure

**HFpEF** : heart failure with preserved ejection fraction

**LVEF** : left ventricular ejection fraction

**PCL** : personalized checklist

**RAAS** : renin-angiotensin-aldosterone system

## **Tables :**

**Table 1** : Baseline characteristics.

**Table 2** : Checklist data at discharge.

**Table 3** : Outcomes at 6 months.

## **Figures :**

**Figure 1** : Two examples of personalized discharge checklist.

**Figure 2** : Flow chart of enrollment and 6-months outcomes.

**Figure 3** : Survival freedom from hospitalization for heart failure (HF).

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# **I. Introduction**

Rehospitalizations are common in patients with heart failure (HF). The rate of readmission after discharge is estimated to 15% at 30 days (1, 2) and up to 50% at 6 months (3) with significant medico-economic impact and poor prognosis. It is estimated that most of the rehospitalizations that occurring in the vulnerability period (i.e. post-discharge) could be avoided (4). Some checklist (CL) have been suggested as a tool to assist physicians in the management of discharge of HF patients in order to reduce early readmissions (5–10). It has been recently demonstrated that the use of a discharge CL yielded a better uptitration of evidence-based medications, a higher referral to telemedicine and a higher proportion of patients with planned medical appointment at discharge (10). There was no difference regarding mortality and HF readmission rate at 6 months of follow-up. The CL used was the same for all HF patients. However, HF is a very heterogeneous syndrome. Patients with preserved or mid-range left ventricular ejection fraction (LVEF) tend to be older and to have more comorbidities. In addition, the benefit of evidence-based medications has been demonstrated only in patients with altered LVEF (11). As a consequence, it is likely that a same discharge CL may not have the same usefulness in all the broad spectrum of patients with HF, leading to the concept of personalized checklist (PCL). We aimed to design an automated personalized discharge CL, depending on major baseline characteristics of HF patients, to help physicians in therapeutic optimization and planning discharge coordination. Then, we evaluate its usefulness in improving quality of care and reducing rehospitalization and mortality rates in this population.

# **II. Methods**

## **A. Checklist.**

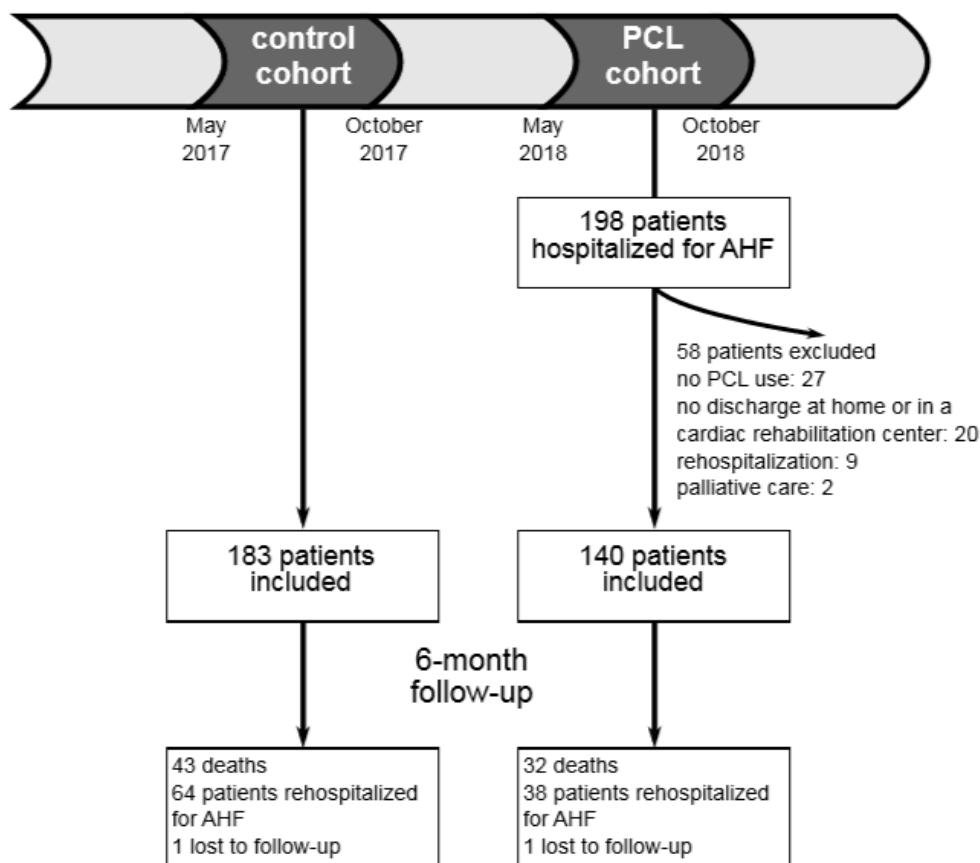
We designed an algorithm according to HF ESC Guidelines (11) (HF-CHECK software, APP, January 2019). Three simple clinical and paraclinical parameters (i.e. age, LVEF and history of HF [de novo, chronic ischaemic HF or chronic non-ischaemic HF]) were computed in order to generate PCL for each patient. The aim of these PCL is to help initial work-up, promote treatment optimization and development of a specific careplan before discharge in patients with decompensated HF. A corrective action may be suggested if a point was not optimized. In addition, the PCL was dynamic as the algorithm was able to add or remove specific points during the completion of the data. As an example, if the rhythm was documented as atrial fibrillation, the PCL suggests to consider to restore sinus rhythm and add the term anticoagulation in the evidence-based medications at discharge. Two examples of algorithm-generated personalized CLs are provided in Figure 1.

A l'entrée		24 - 72h avant la sortie		Jour de la sortie	
<b>Anamnèse</b>		<b>Clinique</b>		<b>Facteur déclenchant</b>	
Facteur décompensant à rechercher	Intox (tabac/OH) à rechercher	Pression artérielle à préciser	Poids à préciser	<b>Education / RHD</b>	
SAS à rechercher		Oedèmes membres inf. à préciser	Dyspnée à préciser	Ed. régime pauvre en sel à préciser	Ed. signes alerte à préciser
<b>Biologie</b>		<b>ECG</b>		<b>Traitements</b>	
NFS, iono, créatininémie à faire	TSH à faire	Fréquence cardiaque à préciser	Rythme sinusal à préciser	Bêta-bloquants E: - S: - Si pas prescrit: -	
BH, EAL, HGT, HbA1C à faire	Bilan martial à faire	Largeur des QRS à préciser		IEC-ARA2-ARNI E: - S: - Si pas prescrit: -	
Albumine à faire	Vitamine D à faire	<b>Echocardiographie</b>		Antagoniste récepteur de l'aldostérone E: - S: - Si pas prescrit: -	
<b>Imagerie</b>				Diurétiques : furosémide E: - S: -	
Rech. cause isch. à discuter	IRM à discuter selon ETT	Récep FEVG possible ? à préciser	Valvulopathie à préciser	Ivabradine E: - S: -	
		<b>Biologie</b>		<b>Programme de suivi</b>	
		BNP à préciser	Créatininémie à préciser	Suivi biologique prescrit	<input type="checkbox"/>
		Hémoglobine à préciser	Carence martiale à préciser	Consultation J7	<input type="checkbox"/>
		Albumine à préciser	Carence vit. D à préciser	HDJ / HDS	<input type="checkbox"/>
				SCAD	<input type="checkbox"/>
				PRADO	<input type="checkbox"/>
				Réadaptation	<input type="checkbox"/>

A l'entrée		24 - 72h avant la sortie		Jour de la sortie	
<b>Anamnèse</b>		<b>Clinique</b>		<b>Facteur déclenchant</b>	
Facteur décompensant à rechercher	Intox (tabac/OH) à rechercher	Pression artérielle à préciser	Poids à préciser	<b>Education / RHD</b>	
SAS à rechercher	Réhospital dans l'année à rechercher	Oedèmes membres inf. à préciser	Dyspnée à préciser	Ed. régime pauvre en sel à préciser	Ed. signes alerte à préciser
<b>Biologie</b>		<b>ECG</b>		<b>Traitements</b>	
NFS, iono, créatininémie à faire	TSH à faire	Fréquence cardiaque à préciser	Rythme sinusal à préciser	Diurétiques : furosémide E: - S: -	
Bilan martial à faire	Albumine à faire	<b>Echocardiographie</b>		<b>Programme de suivi</b>	
Vitamine D à faire		Valvulopathie à préciser		Suivi biologique prescrit	<input type="checkbox"/>
<b>Imagerie</b>		<b>Biologie</b>		Consultation J7	<input type="checkbox"/>
		BNP à préciser	Créatininémie à préciser	HDJ / HDS	<input type="checkbox"/>
		Hémoglobine à préciser	Carence martiale à préciser	SCAD	<input type="checkbox"/>
		Albumine à préciser	Carence vit. D à préciser	PRADO	<input type="checkbox"/>
				Réadaptation	<input type="checkbox"/>
				<b>RDV</b>	
				RDV MT J8	-
				RDV Cardio J30	-
				Date de sortie	
				Cliquez ici pour autoriser la sortie	

Fig. 1. Two examples of personalized discharge checklist. Upper panel : a 42-year old man with de novo heart failure, LVEF=25%. Lower panel : a 82-year old man with hypertension, hospitalized for a new episode of decompensated heart failure without clear precipitating factor. No coronary artery disease. LVEF=60%.



**Fig. 2. Flow chart of enrollment and 6-months outcomes. AHF : acute heart failure, PCL : personalized checklist**

## B. Patient population.

We sought to prospectively include all patients hospitalized for acute decompensated HF from May 2018 to October 2018 in our institution (PCL cohort, Figure 2). Patients were included only if they were discharge at home or in a cardiac rehabilitation center, whatever the LVEF. Exclusion criteria included transfert to a non-capable cardiac rehabilitation hospitalization unit, patients already included in the control group (see below) and patients younger than 18 years. During this period, recommendations on how to use the PCL were regularly provided to medical staff : PCL had to be fulfilled regularly during the hospitalization and before the planned discharge in order to allow therapeutic optimization and follow-up planning. PCL was not intended to replace individual medical judgment or individual patient needs and the attending physician was not enforced to use or follow it for all HF patients. A control cohort was retrospectively included in our institution from May 2017 to October 2017 with the same inclusion and exclusion criteria (Figure 2). For each patient of this control cohort, a PCL was retrospectively fulfilled using medical recordings with the latest available data at the time of discharge. If a patient was hospitalized more than once, he was included at the first hospitalization and the others were counted as readmissions. A patient included in the control cohort and rehospitalized during the PCL period was included in the control group, not in the PCL group.

### **C. Endpoints.**

The primary endpoints were mortality, readmission for HF and a composite criteria of both within 6 months of discharge. Secondary endpoints were defined as quality of care rendered as measured by evidence-based medications, appropriate medication uptitration, correction of deficiencies and planned careplan.

### **D. Statistical Analysis.**

Quantitative variables were described as mean  $\pm$  standard deviation and were compared using Student ttest or Wilcoxon rank sum test when appropriated. Qualitative variables were described as number and percentage and were compared using Fisher exact test. Rates of adverse events were compared between groups using Fisher exact test. A p value $<0.05$  was considered significant. All analyses were performed using R (R Foundation for Statistical Computing, version 3.4.4, Vienna, Austria).

## **III. Results**

### **A. Population characteristics.**

During the inclusion period of the prospective cohort, there was 198 admissions for acute HF. Nine admissions were rehospitalizations of patients already included in the study. Among the remaining 189 patients, 22 were excluded and PCL was not completely fulfilled in 27 patients (Figure 2). The PCL cohort included 140 patients. We retrospectively included 183 patients in the control cohort. One patient was lost to follow-up in each group. Baseline characteristics are depicted in Table 1. The mean age was  $78.1\pm 12.2$  years in the PCL group vs.  $79.0\pm 12.5$  years in the control group ( $p=0.46$ ). Fifty-two patients (28.6%) were hospitalized for de novo HF, as compared to 35 patients (25.2%) in the control group ( $p=0.19$ ). There was no difference regarding LVEF between the groups ( $43.5\pm 13.0\%$  vs.  $41.3\pm 14.8\%$ ,  $p=0.18$ ) or triggering factors among patients with chronic decompensated HF.

**Table 1. Baseline characteristics. Data were expressed as mean  $\pm$  SD or n (%). HF: acute heart failure, LVEF: left ventricular ejection fraction.**

	PCL cohort (n=139)	Control cohort (n=182)	p value
Age, years	78.1 $\pm$ 12.2	79.0 $\pm$ 12.5	0.46
Sex, male	81 (58.3%)	90 (49.5%)	0.15
History of HF			
De novo	35 (25.2%)	52 (28.6%)	0.19
Ischaemic cardiomyopathy	58 (41.7%)	58 (31.9%)	
Non-ischaemic cardiomyopathy	46 (33.1%)	72 (39.6%)	
Hospitalization for HF in the last year	48 (34.5%)	54 (29.7%)	0.40
Trigger factor (chronic HF patients)			
	(n=104)	(n=130)	
Salt intake	15 (14.4%)	33 (25.4%)	0.31
Infection	18 (17.3%)	29 (22.3%)	
Atrial fibrillation or atrial flutter	13 (12.5%)	15 (11.5%)	
Hypertension	11 (10.6%)	12 (9.2%)	
Iatrogenic	7 (6.7%)	7 (5.4%)	
Myocardial ischaemia	5 (4.8%)	4 (3.1%)	
Unknown or other	35 (33.7%)	30 (23.1%)	
LVEF, %	41.3 $\pm$ 14.8	43.5 $\pm$ 13.0	
LVEF < 40%	69 (49.6%)	73 (40.1%)	0.24
LVEF 40-49%	16 (11.5%)	25 (13.7%)	
LVEF $\geq$ 50%	54 (38.8%)	84 (46.2%)	

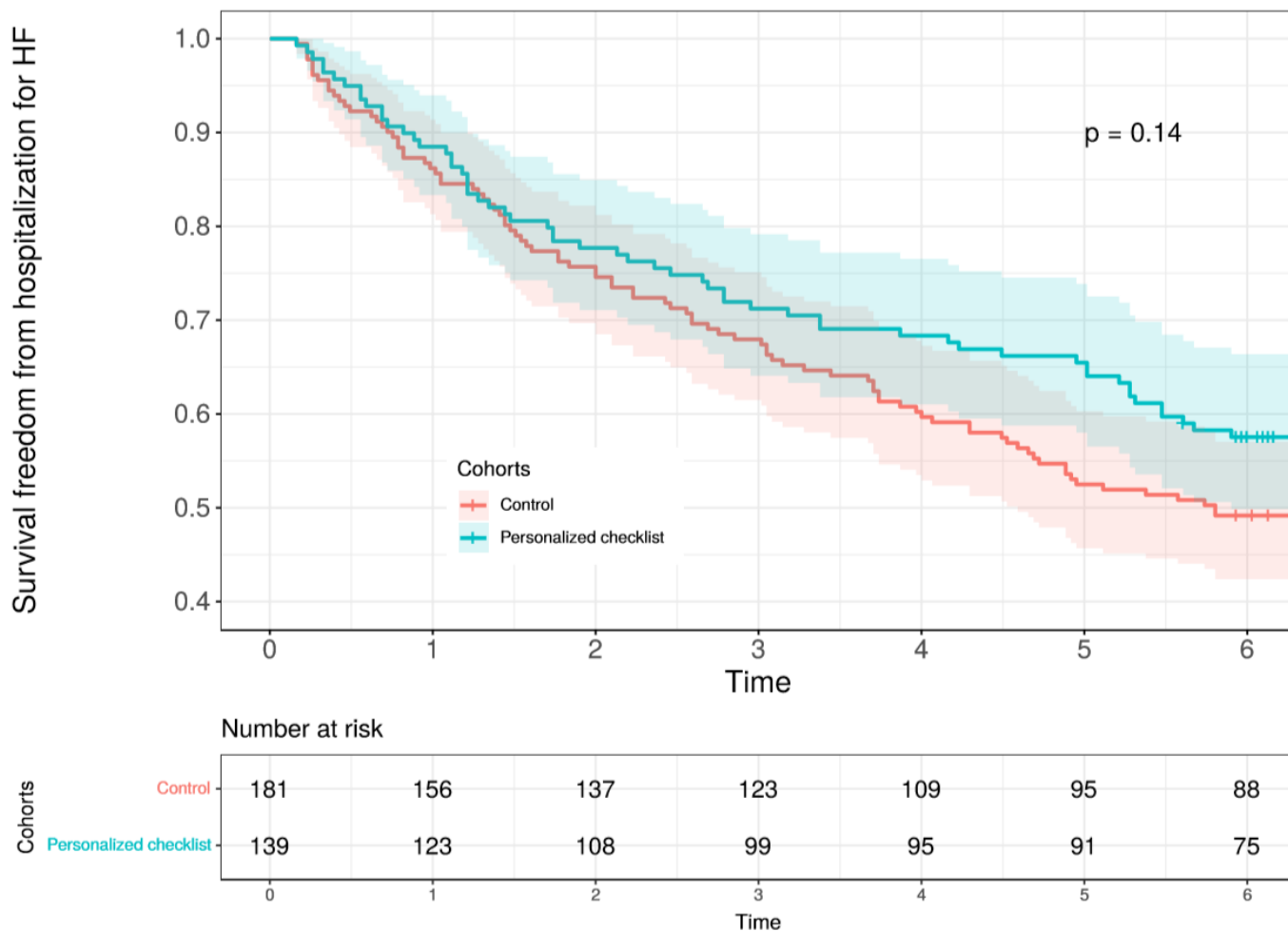
## B. Checklist data.

The results of the CL data are depicted in Table 2. There was no difference among groups regarding the proportion of patients with systolic blood pressure or heart rate in the target ranges. There is less patients with a significant worsening in kidney function (i.e. >20% increase in plasma creatinin levels) in the PCL group (16 patients [11.5%] vs. 39 patients [21.4%],  $p=0.03$ ). Natriuretic peptides measurements were available in 128 patients (92.1%) in the PCL group vs. 150 patients (82.4%) in the control group ( $p=0.02$ ) without significant difference among natriuretic peptides levels when available.



**Table 2. Checklist data at discharge. Data were expressed as n (%) or mean±SD as appropriate. †Only patients with an identified triggering factor during hospitalization. ††Percentages may not add up to 100% due to rounding. † † †A patient could be included in more than one follow-up program. §Only patients with brain natriuretic peptide level available were compared. ACEI: angiotensin-converting enzyme inhibitor, ARB: angiotensin receptor blocker, ARNI: angiotensin-receptor neprilysin inhibitor, BP: systolic blood pressure, HR: heart rate, MRA: mineralo-receptor antagonist, PCL: personalized checklist, SCAD: suivi clinique à domicile.**

	PCL cohort (n=139)	Control cohort (n=182)	p-value
Target Systolic BP	133 (95.7%)	180 (98.9%)	0.09
Target HR	107 (77.0%)	142 (78.0%)	0.28
Correction of a triggering factor†	66 (82.5%)	101 (84.9%)	0.81
<b>Rhythm</b>			
sinus rhythm	71 (51.1%)	93 (51.1%)	0.77
paroxysmal or persistent atrial fibrillation	26 (18.7%)	29 (15.9%)	
permanent atrial fibrillation	42 (30.2%)	30 (33.0%)	
<b>Brain Natriuretic Peptide††</b>			
< 350 ng/mL	50 (39.1%)	71 (47.3%)	0.19
350-700 ng/mL	36 (28.1%)	44 (29.3%)	
≥ 700 ng/mL	42 (32.8%)	35 (23.3%)	
non available	11 (7.9%)	32 (17.6%)	
Creatinin, stable or increase < 20%	123 (88.5%)	143 (78.6%)	0.03
<b>Haemoglobin††</b>			
< 10g/dL	25 (18.0%)	21 (11.5%)	0.26
10-12 g/dL	37 (26.6%)	55 (30.2%)	
≥ 12 g/dL	77 (55.4%)	106 (58.2%)	
<b>Iron deficiency</b>			
ferritin and total saturation of transferrin available	137 (98.6%)	123 (67.6%)	<0.001
no iron deficiency	51 (36.7%)	44 (24.2%)	
iron deficiency, treated with per os iron	32 (23.0%)	21 (11.5%)	
iron deficiency, treated with intravenous iron	42 (30.2%)	44 (24.2%)	
iron deficiency, not treated	12 (8.6%)	14 (7.7%)	
<b>Albumin</b>			
available	139 (100.0%)	167 (91.8%)	0.001
albumin ≥ 35 g/L at discharge	91 (67.4%)	122 (73.1%)	0.35
oral nutritional supplement at discharge	41 (29.5%)	18 (9.9%)	<0.001
<b>Vitamin D</b>			
available	135 (97.1%)	82 (45.1%)	<0.001
correction of vitamin D deficiency	102 (75.6%)	54 (65.9%)	<0.001
<b>Treatments††</b>			
patients with an indication for β-blockers	44 (31.7%)	54 (29.7%)	0.80
dose at admission (% of the recommended dose)	19.6%±24.8%	19.4%±26.8%	0.98
dose at discharge (% of the recommended dose)	29.3%±17.0%	34.3%±23.4%	0.24
no β-blockers at discharge	0	1 (1.9%)	0.81
dose decreased at discharge	5 (11.4%)	5 (9.3%)	
no dose change at discharge	12 (27.3%)	16 (29.6%)	
dose increased at discharge	27 (61.4%)	32 (59.3%)	
patients with an indication for ACEI/ARB/ARNI	53 (38.1%)	61 (33.5%)	0.46
dose at admission (% of the recommended dose)	20.3%±34.5%	25.8%±34.8%	0.40
dose at discharge (% of the recommended dose)	21.7%±19.8%	30.7%±30.2%	0.07
no ACEI/ARB/ARNI at discharge	9 (17.0%)	12 (19.7%)	0.41
dose decreased at discharge	9 (17.0%)	8 (13.1%)	
no dose change at discharge	7 (13.2%)	15 (24.6%)	
dose increased at discharge	28 (52.8%)	26 (42.6%)	
patients treated with a MRA at discharge	17 (13.0%)	20 (11.0%)	0.73
<b>diuretics</b>			
dose of furosemide at admission (mg)	61±77	47±71	0.09
dose of furosemide at discharge (mg)	83±82	69±72	0.12
no furosemide at discharge	14 (10.2%)	19 (10.5%)	0.32
dose of furosemide decreased at discharge	17 (12.4%)	12 (6.6%)	
no dose change of furosemide at discharge	26 (19.0%)	42 (23.2%)	
dose of furosemide increased at discharge	80 (58.4%)	108 (59.7%)	
Planned follow-up† † †	72 (51.8%)	65 (35.7%)	0.006
Prado follow-up program	39 (28.1%)	21 (11.5%)	<0.001
Telemedicine / SCAD program	13 (9.4%)	22 (12.1%)	0.55
Cardiac rehabilitation	27 (19.4%)	23 (12.6%)	0.14



**Fig. 3. Survival freedom from hospitalization for heart failure (HF).**

### C. Outcomes.

During the 6-month follow-up period, 32 patients died in the PCL group (23%) vs. 43 patients in the control group (23.2%,  $p=0.94$ , Table 3). Among patients who died during the 6-month follow-up, 8 patients had palliative care needs at inclusion. Five patients had a severe valvular heart disease (e.g. aortic stenosis with severely depressed LVEF) and two had cardiac amyloidosis. There was no difference regarding HF readmission rate (38 patients in the PCL group [27.3%] vs. 64 patients in the control group [35.2%],  $p=0.12$ ). The survival freedom from readmission for HF at 6 months was 57.6% in the PCL group vs. 49.5% in the control group (Figure 3,  $p=0.14$ ).

## D. Quality of care.

The prevalence of iron deficiency was about two-thirds in the two cohorts but the measurements of both ferritin and total saturation of transferrin was performed in 137 patients (98.6%) in the PCL group vs. 123 patients (67.6%) in the control group ( $p < 0.001$ , Table 2), leading to a higher proportion of patients treated with iron (either per os or intravenous): 74 patients (53.2% of the PCL cohort) vs. 65 patients (35.7% of the control cohort),  $p < 0.01$ . Vitamine D deficiency was better screened and treated in the PCL cohort (102 patients [73.4%] vs. 54 patients [29.7%],  $p < 0.001$ ). Albumin was available in all patients in the PCL cohort and in 168 patients (92.3%) in the control group. However, 41/44 patients (93.2%) with an albumine  $< 35\text{g/L}$  in the PCL group had a prescription of oral nutritional supplement (93.2%) vs. 18/45 (40%) in the control group ( $p < 0.001$ ). There was no difference regarding the proportion of patients with a HF indication of  $\beta$ -blockers or renin-angiotensin-aldosterone system (RAAS) blockers (angiotensin-converting enzyme inhibitors (ACEI), angiotensin receptor blockers (ARB) or angiotensin receptor neprilysin inhibitor (ARNI)): 31.7% in the PCL group vs. 29.7% in the control group ( $p = 0.80$ ) and 38.1% vs. 33.5% ( $p = 0.46$ ), respectively. There was also no difference regarding the baseline and discharge dose of these evidence-based medications or diuretics dose among groups. The post discharge follow-up was better planned in the PCL group as demonstrated by a higher referral to heart failure management, telemedicine or cardiac rehabilitation programs (72 patients [51.8%] vs. 65 patients [35.7%],  $p < 0.01$ ).

**Table 3. Outcomes at 6 months. One patient was lost to follow-up in each group.**

	PCL cohort (n=139)	Control cohort (n=182)	Hazard Ratio HR [95%CI]	p value
Primary composite outcome (mortality, readmission for HF)	59 (42.4%)	92(50.5%)	0.72 [0.46-1.12]	0.14
All-cause death	32 (23.0%)	43 (23.2%)	0.99 [0.58-1.67]	0.94
Readmission for HF	38 (27.3%)	64 (35.2%)	0.69 [0.43-1.12]	0.12

## IV. Discussion

We did not demonstrate a reduction of mortality or HF readmissions using our discharge PCL. There was no difference regarding the use of evidence-based medications such as  $\beta$ blockers or RAAS blockers in the subset of patients with altered LVEF. However, the use of personalized algorithm-based checklists yielded a significant improvement in the screening programs. In the present study, we found a readmission rate for HF of 27.3% in the PCL cohort and 35.2% in the control cohort at 6 months. This is similar to the rate we observed in our previous study (10). At 3 months, the mortality rate we observed was 12.9% and 13.8% in the PCL cohort and the control cohort, respectively. The mortality rate that has been reported in OPTIMIZE-HF (12) and GREAT (13) registries were lower (6.7% and 7% respectively at 3 months) but our patients were older (78.6 years vs. 73 years and 72 years, respectively). A 3-month postdischarge mortality of 14.7% has been reported in a population of HF patients  $\geq 75$  years old (14). At last, the mortality rate was also lower in our previous study (10) (12.1% at 6 months) but the population was different since we include in the present work a significant proportion of patients denied for surgical or transcatheter aortic valve replacement, palliative care needs or cardiac amyloidosis that are conditions associated with poor outcomes.

The present study showed that the use of a personalized algorithm-generated discharge checklist did not improve outcomes in patients hospitalized for acute HF. In our pilot study, the use of the same standardized checklist for all HF patients was neither associated with an improvement in mortality or HF readmission rate (10). Some explanations could be advanced. First, it has been demonstrated that the administration of HF oral therapies, including  $\beta$ -blockers and RAAS inhibitors is associated with better survival of patients hospitalized for acute HF (13). In our study, some patients with altered LVEF were not treated with  $\beta$ -blockers or RAAS inhibitors at discharge because of contraindications. Overall, only a third of patients included in the two cohorts had an indication for both  $\beta$ -blockers and RAAS inhibitors. As a consequence, it was not possible to prescribe evidence-based medications in about 70% of patients. Second, the uptitration of the aforesaid therapies was probably not optimal as there was only a slight increase of the dose of medications at discharge. In addition, 9 patients (17.0%) in the PCL cohort were not treated with a RAAS blocker despite being indicated, mostly because of the worsening of the kidney function with diuretic therapy, despite a better kidney function in the latter group ( $p=0.03$  vs. control group). It has been demonstrated that shorter length of stay is associated with an increase in readmission rates in patients hospitalized for acute HF (15) and that administration of RAAS inhibitors is associated with better outcomes (13). In case of a transient worsening of kidney function, it may be preferred to postpone discharge in order to introduce or resume RAAS blockers. At last, patients were included in a single center which had already published about the usefulness of a discharge checklist (10). As a consequence, it may decrease the benefit of our discharge PCL as our control cohort was included by practitioners that were used to perform discharge checklist in patients with decompensated HF in a daily setting.

The algorithm was built according to HF ESC guidelines 2016 (11). Because it was based on the prevention of cardiovascular triggering factors of acute HF and the up-titration of evidence-based therapies, our personalized discharge CL may be less effective in patients with heart failure with preserved ejection fraction (HFpEF). We included items about the screening and the treatment of comorbidities and frailty like iron deficiency, vitamin D deficiency or malnutrition, that are common findings in patients with heart failure, including older patients with HFpEF (16–18). The use of our algorithm yielded a significant improvement of the treatment of iron deficiency, vitamin D deficiency and malnutrition in the PCL cohort when compared to the control cohort. The correction of an iron deficiency with ferric carboxymaltose in symptomatic HF patients with a LVEF $\leq$ 45% led to an improvement in quality of life from week 12 onwards in the CONFIRM-HF trial (19). There is also growing evidence that vitamin D is a potent regulator of the hepcidin-ferroportin axis and may have a role in iron homeostasis (20). Vitamin D deficiency may be implicated in the pathophysiology of HF with altered LVEF through activation of the RAAS, impaired calcium handling, exaggerated inflammation, secondary hyperparathyroidism, pro-fibrotic properties, and proatherogenic potential (21). Lower vitamin D levels were associated with reduced functional capacity in patients with diastolic dysfunction or HFpEF and were predictive for an increased rate of cardiovascular hospitalizations (22). Liu et al. described that low vitamin D levels were associated with activation of RAAS, inflammation and poor prognosis (23). However, there is controversial data about the usefulness of supplemental vitamin D in patients with symptomatic HF. A daily vitamin D dose of 4000 IU did not reduce mortality in patients with advanced HF in the EVITA trial (24) and was associated with a greater need for mechanical circulatory support. Conversely, two recent meta-analysis showed that vitamin D treatment could potentially improve cardiac function in patients with HF (25, 26). Cachexia and sarcopenia are common in patients with HF and are associated with pro-inflammatory immune activation, neurohormonal dysfunction, poor nutrition and malabsorption, impaired calorie and protein balance, anabolic hormone resistance, reduced anabolic drive, prolonged immobilization and physical deconditioning, together characterized by catabolic/anabolic imbalance (27). It has been recently demonstrated that malnutrition is a common finding in very elderly patients hospitalized for HF and is an independent predictor of mortality (18). However, there is no clear data about the benefit of nutritional supplements in patients with HF.

The use of our algorithm-based discharge CL was not associated with a significant decrease regarding HF readmission rate at 6 months (38 patients [27.3%] vs. 64 patients [35.2%], HR = 0.69, 95%CI [0.43-1.12],  $p=0.12$ ) but the curves tend to separate at the second month after the discharge. It could be hypothesized that the significant correction of deficiencies may improve patients general condition. Further larger studies investigating the usefulness of the systematic screening and correction of deficiencies on outcomes are warranted, particularly in older patients with HFpEF. The use of PCL was associated with a high referral to follow-up programs, including telemedicine or cardiac rehabilitation programs. It has been previously demonstrated that lower risk-standardized 30-day readmission rates were associated with strategies including partnering with community physicians and nurses and

arranging follow-up appointments before discharge (28). In addition, cardiac rehabilitation was associated with modest significant reductions for both all-cause mortality or hospitalization and cardiovascular mortality or heart failure hospitalization after adjustment for highly prognostic predictors of the primary end point in the HF-ACTION randomized trial (29).

Our study has some limits. First, it was a single center study with a relatively small number of patients. Second, our center already published about the usefulness of discharge checklist in patients with decompensated HF and the careplan of the patients included in the control cohort may be already partially optimized. Third, we did not assess if the use of the PCL lead to specific modification in therapies or careplan for a given patient. Fourth, CL was not used in all patients admitted for decompensated acute HF as physicians were not enforced to use it. Despite being simple and taking approximately only 5 minutes per patient discharge, the use of such a tool may be too long in a daily setting.

## **V. Conclusion**

The use of an algorithm-based personalized discharge checklist was not associated with an improvement in mortality rate at 6 months in patients with decompensated heart failure. However, there was a non-significant trend towards a reduction regarding HF readmissions, a significant higher referral to follow-up programs and a better screening and treatment of malnutrition, iron and vitamin D deficiencies. A multicenter study is warranted to assess the usefulness of a simple costless personalized checklist in the setting of decompensated heart failure in a large HF patients population.

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de l'Université de CAEN et P.O

Le Doyen

ANNEE DE SOUTENANCE : **2019**

NOM ET PRENOM DE L'AUTEUR : **ALLAIN FLORENT**

TITRE DE LA THESE : **Checklist de sortie basée sur un algorithme personnalisé chez les patients admis pour décompensation cardiaque.**

RESUME DE LA THESE EN FRANÇAIS :

**Introduction.** L'utilisation d'une checklist de sortie chez les patients admis pour insuffisance cardiaque (IC) a montré une amélioration de la qualité de vie mais n'est pas applicable pour toutes les IC.

**But.** Evaluer l'intérêt d'une checklist de sortie personnalisée (CLP) basée sur des caractéristiques simples (âge, fraction d'éjection ventriculaire gauche (FEVG) et type d'IC) sur la mortalité, les réadmissions pour IC et la qualité de vie.

**Méthodes.** Nous avons prospectivement inclus 139 patients hospitalisés pour IC entre Mai 2018 et Octobre 2018. Une CLP était créée pour chaque patient et remplie avant la sortie. Un groupe contrôle de 182 patients était rétrospectivement inclus l'année précédente. Le critère primaire était la mortalité et les réadmissions à 6 mois pour IC.

**Résultats.** Les cohortes CLP et contrôle étaient comparables sur les caractéristiques de la population comme l'âge moyen et la FEVG. Durant les 6 mois de suivi, 32 patients (23%) étaient décédés dans le groupe CLP contre 43 patients (23.2%) dans le groupe contrôle ( $p=0.94$ ). 38 patients (27.3%) étaient réadmis pour IC dans le groupe CLP contre 64 (35.2%) dans le groupe contrôle avec une divergence des courbes à 2 mois ( $p=0.12$ ). On observait dans le groupe CLP un plus grand taux de patients pris en charge pour les carences en fer, vitamine D et la dénutrition ainsi qu'un plus grand recours aux programmes de suivi (réadaptation cardiaque, télémédecine et PRADO).

**Conclusion.** L'utilisation d'une CLP chez les patients IC ne montre pas de différence sur la mortalité et les réadmissions pour IC. Cependant, une meilleure gestion des comorbidités et un plus grand recours aux programmes de suivis sont observés.

MOTS CLES : insuffisance cardiaque, check-list de sortie, réhospitalisation

TITRE DE LA THESE EN ANGLAIS : **A personalized algorithm-based discharge checklist in patients with acute heart failure.**

RESUME DE LA THESE EN ANGLAIS :

**Background.** The use of a discharge checklist in patients with acute heart failure (HF) yields a better quality of care, but a single tool may not be suitable in all HF patients.

**Aims.** Evaluate the usefulness of an algorithm-generated personalized discharge checklist (PCL) based on simple baseline characteristics (age, left ventricular ejection fraction (LVEF) and history of HF) on mortality, readmission for HF and quality of care.

**Methods.** We prospectively included 139 patients hospitalized for HF from May 2018 to October 2018. A PCL was created for each patient and had to be fulfilled before discharge. A control cohort of 182 patients was retrospectively included from precedent year. The primary endpoint was mortality and readmission for HF at 6 months.

**Results.** There was no difference among baseline characteristics between PCL and control cohorts regarding mean age and LVEF. During the 6-month follow-up period, 32 patients (23%) died in the PCL cohort vs. 43 patients (23,2%) in the control cohort ( $p=0.94$ ). 38 patients (27.3%) were hospitalized for HF in the PCL cohort vs. 64 (35.2%) in the control cohort with curves divergence at 2 months ( $p=0.12$ ). A higher proportion of patients were screened and treated for iron and vitamin D deficiencies as malnutrition supplemented in the PCL group. The post discharge follow-up was better planned in the PCL group were enrolled in a cardiac rehabilitation, telemedicine or PRADO program.

**Conclusion.** There was no difference regarding mortality and HF rehospitalization rate using a PCL in HF patients. However, an improvement in the management of HF comorbidities and a better referral to follow-up programs were observed.

KEY WORDS : heart failure, discharge checklist, rehospitalisation