Can Vertical Integration Reduce Hospital Readmissions? A Difference-in-Differences Approach

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Background: Vertical integration is expected to improve communication and coordination between inpatient care and care after discharge. Despite being used across health systems worldwide, evidence about its impact on readmissions is sparse and contradictory.

Objective: To assess the impact of vertical integration on hospital readmissions.

Research Design, Subjects, and Measures: Using difference-in-differences we compared readmissions before and after vertical integration in 6 Portuguese hospitals for years 2004–2013. A control group with 6 similar hospitals not integrated was utilized. Considered outcome was 30-day unplanned readmission. We used logistic regression at the admission level and accounted for patients' risk factors using claims data. Analyses for each hospital and selected conditions were also run.

Results: Our results suggest that readmissions decreased overall after vertical integration [odds ratio (OR) = 0.900; 95% confidence interval (CI), 0.812–0.997]. Hospital analysis indicated that there was no impact for 2 hospitals (OR = 0.960; 95% CI, 0.848–1.087 and OR = 0.944; 95% CI, 0.857–1.038), and a positive effect in 4 hospitals (greatest effect: OR = 0.811; 95% CI, 0.736–0.894). A positive evolution was observed for a limited number of conditions, with better results for diabetes with complications (OR = 0.689; 95% CI, 0.525–0.904), but no impact regarding congestive heart failure (OR = 1.067; 95% CI, 0.827–1.377).

Conclusions: Merging acute and primary care providers was associated with reduced readmissions, even though improvements were not found for all institutions or condition-specific groups. There are still challenges to be addressed regarding the success of vertical integration in reducing 30-day hospital readmissions.

Key Words: integrated care, delivery of health care, readmissions, quality improvement, international health

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Health systems around the world seek to increase the continuity of care between providers at different levels.[1–3] By merging health care providers of different levels into a single unit,[4] vertical integration is a means to reduce fragmentation of care and its negative consequences, especially for older patients or those with multiple chronic conditions, whose disease trajectories typically require contact with several types of providers.[5] A study conducted in 11 countries showed that the population above 65 years old frequently sees >4 different doctors per year, or takes >4 medications; and also that in 10 countries ≥20% reported receiving uncoordinated care, with values even higher for some countries.[6]

Avoidable readmissions are one of the negative consequences of fragmentation of care, due to poor care transitions between providers.[7,8] Vertical integration is therefore expected to reduce readmissions, which is advantageous for patients and providers, as readmissions are frequent,[9,10] expose patients to avoidable risks,[11] disrupt their routine,[12] and are costly.[9] Readmissions depend on patients' risk factors, but are partially avoidable through changes in care delivery and organization.[13] These changes may include predischarge interventions, postdischarge interventions, or bridging interventions, with better results for more comprehensive interventions.[14]

From 1999 to 2012, 8 vertically integrated units were created by the Portuguese Ministry of Health, which merged hospitals and primary care public providers sharing a common geographical location, aiming to improve efficiency, effectiveness, and population-level outcomes.[15–21] In each case the intervention from the Ministry of Health was to merge existing providers of different levels of care into a new single institution—Local Health Unit (LHU)—and to

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define the new organization design. This intervention occurred in a limited number of providers, whereas others remained unaltered. LHUs are entirely accountable for health care delivery, health promotion, and public health of the population in the catchment area. In 2014 integrated providers were accountable for 11.6% of the population in the country.[22]

Although there are increasing needs for coordination between providers, our understanding of the relationship between vertical integration and readmissions is still insufficient to guide future developments, as there is mixed evidence about it. An increased level of integration between acute and primary care has been shown to reduce readmissions,[23–25] but other studies indicate that benefit occurred but only for some patients,[26] whereas reviews on this subject report both a positive effect and its absence.[27–30] Despite its important findings, prior research focused mainly on interventions aimed at partial components of care provision or specific groups of patients.[24,25,27–30] A study focusing on organizational-level integration reports that nonintegrated providers had a higher risk of readmission for people aged 65 and over [odds ratio (OR) = 1.10; 95% confidence interval (CI), 1.03–1.16].[26] However, these results were not consistent by condition, as the opposite was found for diabetes, and for 3 conditions there were no significant differences (chronic obstructive pulmonary disease, hypertension, and congestive heart failure).[26] More recent studies about accountable care organizations show that the readmission rate was 1.3% higher in accountable care organizations with less primary care orientation.[23]

The need remains to compare the same providers in the prevertical and postvertical integration periods. In this study, we expand on the literature by looking at the evolution of readmissions after the creation of providers integrated at a complete organizational level targeting health of the whole population in a geographic area, and then comparing that evolution with the evolution of nonintegrated providers, over a 10-year period.

This study assesses the impact of vertical integration on hospital readmissions in Portugal, with a view to generate evidence relevant to monitor existing integrated providers and to decide upon the creation of new ones.

METHODS

Study Design

We compared unplanned 30-day readmissions before and after vertical integration in 6 hospitals transitioned to vertically integrated units in a 10-year period (2004–2013). The independent effect of vertical integration on hospital readmissions was assessed at the admission level with a difference-in-differences technique. Accordingly, the 6 hospitals transitioned to vertically integrated units formed the intervention group, and a control group of 6 institutions having similar characteristics was utilized. The occurrence of a 30-day unplanned readmission was the outcome considered as dependent variable (1: readmitted). We used logistic regression and accounted for the impact of patients' risk factors and systemic-level effects. We assessed changes on readmissions after vertical integration for each hospital and selected conditions.

Data Sources and Inclusion/Exclusion Criteria

Administrative data on inpatient care were provided by the Central Administration of Health System[31] and included sex, age, principal diagnosis, secondary diagnoses, procedures, discharge hospital, admission type, admission and discharge dates, discharge status, and a random unique patients' identifier.

Diagnoses and procedures were coded according to the International Classification of Diseases—9th version—Clinical Modification. Nineteen secondary diagnoses were considered. To guarantee anonymity the patients' unique identifier was randomly generated solely for this database by the institution providing the data.

The study sample included admissions to the hospitals included in the intervention or control group in years 2004–2013 (1,597,159). We excluded 469 admissions for data quality reasons (0.03%); deceased, transferred, or left against medical advice (147,946; 9.3%); for which discharge date occurred in the last 30 days of each civil year impeding a 30-day follow-up (112,838; 7.1%); or admitted for psychiatric diagnoses, rehabilitation, or medical treatment of cancer (67,375; 4.2%). As vertical integration effects need time to occur, the 6-month period after the intervention was excluded (71,697 admissions, 4.5%). There were no missing data on variables included in the study.

Period and Vertical Integration Status

Available data concerned the 2004–2013 period, which allowed us to include 6 of the 8 LHUs existing in 2013. There were no data on the preintervention period for the first experience of vertical integration (1999), and the most recently integrated unit (2012) was also excluded, as only 1 full year of data following the intervention year was available. Vertical integration of the hospitals studied occurred in February 2007 (1 hospital), September 2008 (3), November 2009 (1), and June 2011 (1).[16–19]

Hospitals did not self-volunteer to be integrated and the reduction of readmissions was not the main goal of vertical integration,[15–21] so it was not necessary to account for these factors in the study design.

We considered 2 vertical integration statuses: hospitals transitioned to vertically integrated units (intervention group) and hospitals not vertically integrated (control group). The control group included 6 hospitals that were not vertically integrated to consider systemic-level effects affecting the evolution of readmissions during the period besides vertical integration. The control group included only hospitals in the same benchmarking group as intervention group hospitals. These clusters were previously defined by a central health authority (Central Administration of Health System) for benchmarking purposes, using hierarchical clustering and principal component analyses.[32] Specialty hospitals, public-private partnerships, and hospitals with a large difference in volume of admissions were not candidates to be included in the control group. Dimension of hospitals in the control group was slightly smaller, but there was a concentration in the range of 250–400 beds in both groups (3 in both). We compared the evolution of readmissions rate in the control group to the evolution of all hospitals in mainland Portugal. Between 2004 and 2013 the readmission rate grew 1% overall (from 3.8% to 4.8%) and 1.1% in the control group (from 5.1% to 6.2%) [see yearly values in Supplementary Digital Content (SDC), Appendix 1, Supplemental Digital Content 1, http://links.lww.com/MLR/B347]. All hospitals are not-for-profit public providers.

Dependent Variable

The primary outcome was unplanned 30-day readmissions, acute clinical events requiring urgent hospitalization within 30 days of discharge, identified as defined elsewhere (indicator variable, 1: readmitted).[33] Study was conducted at the admission level, and the dependent variable was occurrence of readmission. We selected index admissions from hospitals considered in the study, but the readmission may have occurred at any public hospital in mainland Portugal.

Statistical Analysis

Characterization of the population studied included absolute and relative frequency by vertical integration status of sex, age group (0–17, 18–64, 65–84, 85+ y), condition (acute cerebrovascular disease; congestive heart failure, nonhypertensive; diabetes mellitus with complications; pneumonia; and urinary tract infections), and comorbidities (congestive heart failure; coronary atherosclerosis or angina, cerebrovascular disease; diabetes mellitus; iron deficiency or other unspecified anemias and blood disease; other infectious diseases and pneumonias; specified arrythmias) in 2004–2013. We selected these conditions based on their high frequency of admissions and readmissions. Yearly readmission rates for intervention and control group were also computed (number of readmissions/number of admissions).

To assess the relationship between readmission and the change to a vertically integrated unit we used logistic regression (1: readmitted) in a difference-in-differences technique. We first analyzed all admissions in the dataset, then we compared each hospital individually with the control group, and finally we ran a condition-specific analysis. This allowed us to study the impact of vertical integration at an overall level, at each unit of intervention, and for specific groups of patients.

To develop the 10-year difference-in-differences model, we computed a continuous time variable consisting of time difference in months between patients' date of admission and date of vertical integration for each hospital in the intervention group. As no vertical integration occurred for the control group, that variable was computed by assuming dataset mid-point as the intervention date. On the basis of that, an indicator variable distinguishing patients admitted after vertical integration (intervention group) or after mid-point (control group) was included in the model (1: after). Another indicator variable categorized patients admitted to the intervention group (1: intervention group). The interaction term between these 2 indicator variables gives an estimate of the independent effect of the intervention on the outcome studied: an OR significantly <1 indicates a reduction of risk of readmission after vertical integration. To address potential sources of bias we included 3 covariates: individual risk of readmission, hospital of treatment, and the continuous time variable (see SDC, Appendix 2, Supplemental Digital Content 2, http://links.lww.com/MLR/B348 for more details). Individual risk of readmission was based on age, disease, and comorbidities,[33] and model discrimination was between 0.60 and 0.71 (values similar to those found by original authors). This risk of readmission was computed with a hierarchical logistic regression model from a larger database including all public hospitals in mainland Portugal (7,329,979 admissions), so that estimates were more stable (further details in SDC, Appendix 3, Supplemental Digital Content 3, http://links.lww.com/MLR/B349).

In the provider-specific analysis, we compared each hospital in the intervention group with all hospitals in the control group.

We also tested the consistency of impact of vertical integration across a group of selected conditions: acute cerebrovascular disease; congestive heart failure, nonhypertensive; diabetes mellitus with complications; pneumonia; and urinary tract infections.

Finally, to test whether our results were robust to a change in the period studied, we ran a sensitivity analysis for provider-specific analysis in which we included only the 24 months before and 24 months after date of vertical integration. This model included the same variables as the baseline model. However, it was not necessary to utilize the data set mid-point, as the date of vertical integration of each provider was considered for intervention and control groups.

Individual risk of readmission was computed with SAS University Edition. All other analyses were run with Stata 13.0. A level of significance of 95% was considered in the study.

RESULTS

The final sample included 1,196,834 admissions during 2004–2013, of which 589,583 (49.3%) were admitted to hospitals transitioned to vertically integrated units (Table 1). Remaining admissions were treated in hospitals not vertically integrated (50.7%).

From 2004–2013, patients treated at hospitals transitioned to vertically integrated units were similar to those treated at hospitals not vertically integrated, except for the fact that they were older in the first group (above 65 y: 42.8% vs. 39.3%). All remaining absolute differences between percentages were $\leq 1\%$ when we considered sex, age, condition, and comorbidities.

The overall readmission rate was 5.1% (4.8% in the intervention group; 5.4% in the control group). Throughout the 10-year period (2004–2013), yearly readmission rate was lower at hospitals transitioned to a vertically integrated unit (Fig. 1). In 2008, the difference between the intervention and control group increased (2004–2008: range, 0.2%–0.5%; 2009–2013: range, 0.7%–1.1%).

The crude readmission rate fell after vertical integration from 4.9% to 4.5%, whereas it increased in the

TABLE 1. Patient Characteristics by Vertical Integration Status, 2004–2013

Characteristics	No. Admissions [n (%)] Hospitals Not Vertically Integrated (n = 607,251)	Hospitals Transitioned to Vertically Integrated Units (n = 589,583)
Sex		
Male	260,670 (42.9)	258,700 (43.9)
Female	346,581 (57.1)	330,883 (56.1)
Age group (y)		
0–17	111,493 (18.4)	97,894 (16.6)
18–64	256,750 (42.3)	238,841 (40.5)
65–84	191,993 (31.6)	204,289 (34.6)
85+	47,015 (7.7)	48,559 (8.2)
Condition		
Pneumonia	29,016 (4.8)	26,006 (4.4)
Acute cerebrovascular dx	16,145 (2.7)	16,556 (2.8)
CHF; nonhypertensive	15,026 (2.5)	11,530 (2.0)
Urinary tract infections	15,941 (2.6)	9775 (1.7)
DM with complications	6998 (1.2)	9623 (1.6)
Comorbidities		
Diabetes mellitus	59,478 (9.8)	55,462 (9.4)
Coronary atherosclerosis or angina, cerebrovascular dx	39,526 (6.5)	39,008 (6.6)
Specified arrhythmias	34,718 (5.7)	32,764 (5.6)
Iron deficiency or other unspecified anemias and blood dx	27,401 (4.5)	29,673 (5.0)
Congestive heart failure	28,271 (4.7)	28,043 (4.8)
Other infectious dx and pneumonias	29,040 (4.8)	26,709 (4.5)

The final sample included 1,196,834 admissions, with 49.3% admitted to hospitals transitioned to vertically integrated units.

CHF indicates congestive heart failure; DM, diabetes mellitus; dx, disease.

control group (5.2%–5.6%) (Table 2). Results from the difference-in-differences technique suggest that after adjusting for patients' characteristics and systemic-level effects, readmissions decreased after vertical integration (OR = 0.900; 95% CI, 0.812–0.997).

Considering the period 2004–2013, readmission rate decreased in 2 hospitals (H1 = 3.9%–3.2%; H4 = 5.6%–5.0%) and increased in 1 hospital (H3 = 5.6%–6.3%) (Table 3). In the remaining hospitals absolute variations were <0.3%. We found that the risk of readmission decreased after vertical integration in 4 providers compared with the control group. We observed a significant reduction from 19% (H1 = 0.811; 95% CI, 0.736–0.894) to 10% (H6 = 0.891; 95% CI, 0.809–0.981 and H4 = 0.893; 95% CI, 0.806–0.988). For 1 hospital, there was a more moderate reduction (H5 = 0.911; 95% CI, 0.827–1.003). We found no effect for 2 providers (H3 = 0.960; 95% CI, 0.848–1.087 and H2 = 0.944; 95% CI, 0.857–1.038). Moreover, we observed that reduction

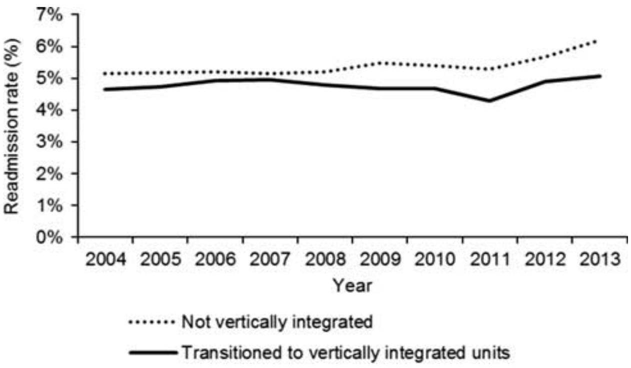

FIGURE 1. Yearly readmission rate (%) by vertical integration status, 2004–2013. Overall readmission rate was 5.1% (4.8% in hospitals transitioned to vertically integrated units, 5.4% in hospitals not vertically integrated). The period studied is 2004–2013, and the 6 months after vertical integration were excluded (n = 1,196,834 admissions).

occurred among providers with high and low readmission rates (H4 = 5.6% before vertical integration; H6 = 5.0%; H1 = 3.9%; H5 = 3.8%).

We observed a considerable reduction of crude readmission rates for patients with diabetes mellitus with complications after vertical integration, from 8.8% to 6.2% (Table 4). For the remaining selected conditions, absolute variations were <0.3%. The estimate of the impact of vertical integration indicated that there was a strong reduction of risk of readmission among patients with diabetes mellitus with complications (0.689; 95% CI, 0.525–0.904) and urinary tract infections (0.762; 95% CI, 0.648–0.897). For patients with pneumonia there was also a reduction of risk of readmission (0.855; 95% CI, 0.751–0.972). No effect was found for patients with congestive heart failure (1.067; 95% CI, 0.827–1.377) or acute cerebrovascular disease (0.944; 95% CI, 0.734–1.214).

Results from the sensitivity analysis were similar to the baseline analysis. We observed a reduction of readmissions after vertical integration in 4 institutions (H1, H4, H5, and H6) and no effect at 2 (H2 and H3).

DISCUSSION

A major system change occurred in the Portuguese National Health Service when several hospitals and primary care public providers were merged into a single institution (LHU). In this study, we found that risk of readmission decreased overall following vertical integration. Even if there was no effect for 2 hospitals, impact was positive in 4 hospitals. Impact of vertical integration was heterogenous in different groups of patients: there was a clear reduction of risk of readmission especially of patients with diabetes mellitus with complications and urinary tract infections. However, there was no effect for patients admitted for congestive heart failure or acute cerebrovascular disease. Our overall findings are consistent with the literature reporting a positive impact of organizational-level integration on readmissions,[23] and also the existence of differences between conditions.[26]

TABLE 2. Readmission Rate (%) Before and After Vertical Integration, and Adjusted Difference-in-Differences Estimate of the Impact of Vertical Integration on Readmissions, 2004–2013

Vertical Integration Status	Readmission Rate (%) Before Vertical Integration	Readmission Rate (%) After Vertical Integration	Estimate of the Impact of Vertical Integration on Readmissions (95% CI, *P*)
Transitioned to vertically integrated units	4.9	4.5	0.900 (0.812–0.997), $P=0.045$
Not vertically integrated	5.2	5.6	

The estimates are derived from a difference-in-differences logistic regression model and give an estimate of the independent effect of vertical integration on readmissions, based on an odds ratio. Values significantly <1 indicate a reduction of readmissions following vertical integration. Results are presented relative to a control group of hospitals that did not transition to a vertically integrated unit. The period studied is 2004–2013 and the 6 months after vertical integration were excluded (n = 1,196,834 admissions).

CI indicates confidence interval.

Our study demonstrates that vertical integration had a positive impact on readmissions in 4 of the 6 institutions. A possible insight into the context and process of implementation[34] of vertical integration is provided by the perception of professionals regarding the level of integration achieved. Earlier studies sought to evaluate the perception of integration in hospitals transitioned to vertically integrated units in Portugal. A group of 544 individuals was queried in 2010, and the same questionnaire was used again in 2015 (n = 294).[35,36] These groups included physicians from primary and acute care, and managers from top and intermediate levels from institutions studied. Available evidence indicated that the professionals' perceptions of integration had increased with time and some institutions achieved higher levels of integration, which is in line with the differences in scale of the impact that we observed. The relationship between the perception of integration at each provider and the impact of vertical integration on readmissions needs to be studied further. Also, detailed knowledge from case studies on differences between providers that sheds light on enablers of and barriers to vertical integration is needed. Still, it is important to note that earlier studies have shown that readmissions are a multifactorial event, and in some cases difficult to reduce even with initiatives aimed directly at that purpose.[37,38]

Moreover, it should be highlighted that this was a policy-level change, as the Ministry of Health defined centrally which providers would be merged and central initiatives were limited, leaving to each institution the responsibility to increase integration at the operational level, choosing which initiatives to pursue and their content. Therefore, we can expect that process and measures of implementation may have differed among institutions, which is consistent with the different scale of impacts we found by institution.

The evolution of readmissions was different depending on condition, which adds to the complexity of the mechanisms that link vertical integration and readmissions. Possible explanations include the fact that readmissions for some conditions may be more susceptible to integration between acute and primary care or there were differences in the collaboration between primary care and hospital professionals that differed between conditions. These findings warrant further study, but the involvement of professionals in the vertical integration process, particularly physicians, is a condition for the success of this organizational change.[39] The reduction of readmissions from patients with complicated diabetes is the greatest effect detected in our study, as the risk of readmission decreased nearly 30%. In Portugal, there is a national program for the control of

TABLE 3. Readmission Rate (%) Before and After Vertical Integration, and Adjusted Difference-in-Differences Estimate of the Impact of Vertical Integration on Readmissions for Each Hospital Transitioned to a Vertically Integrated Unit, 2004–2013

Hospitals	Readmission Rate (%) Before Vertical Integration	Readmission Rate (%) After Vertical Integration	Estimates of the Impact of Vertical Integration on Readmissions (95% CI, *P*)
H1	3.9	3.2	0.811 (0.736–0.894), $P<0.001$
H2	4.7	4.8	0.944 (0.857–1.038), $P=0.234$
H3	5.6	6.3	0.960 (0.848–1.087), $P=0.521$
H4	5.6	5.0	0.893 (0.806–0.988), $P=0.029$
H5	3.8	3.8	0.911 (0.827–1.003), $P=0.058$
H6	5.0	4.7	0.891 (0.809–0.981), $P=0.019$

H1–H6 are the hospitals transitioned to vertically integrated units. The estimates are derived from a difference-in-differences logistic regression model and give an estimate of the independent effect of vertical integration on readmissions, based on an odds ratio. Values significantly <1 indicate a reduction of readmissions following vertical integration. Results are presented relative to a control group of hospitals that did not transition to a vertically integrated unit. The period studied is 2004–2013 and the 6 months after vertical integration were excluded (n ≥ 674,213 admissions).

CI indicates confidence interval.

TABLE 4. Readmission Rate (%) Before and After Vertical Integration, and Adjusted Difference-in-Differences Estimate of the Impact of Vertical Integration on Readmissions for Selected Conditions, 2004–2013

	Readmission Rate (%)		
Conditions	**Before Vertical Integration**	**After Vertical Integration**	**Estimate of the Impact of Vertical Integration on Readmissions (95% CI, *P*)**
Pneumonia			
Transitioned to vertically integrated units	8.2	8.2	0.855 (0.751–0.972), $P=0.017$
Not vertically integrated	9.6	11.0	
Acute cerebrovascular disease			
Transitioned to vertically integrated units	5.3	5.1	0.944 (0.734–1.214), $P=0.653$
Not vertically integrated	7.1	7.6	
Congestive heart failure, nonhypertensive			
Transitioned to vertically integrated units	10.5	10.2	1.067 (0.827–1.377), $P=0.616$
Not vertically integrated	14.0	13.1	
Urinary tract infections			
Transitioned to vertically integrated units	9.1	9.1	0.762 (0.648–0.897), $P=0.001$
Not vertically integrated	9.1	11.5	
Diabetes mellitus with complications			
Transitioned to vertically integrated units	8.8	6.2	0.689 (0.525–0.904), $P=0.007$
Not vertically integrated	10.2	11.3	

Selection of conditions included in the table is based on their high frequency of admissions and readmissions. The estimates are derived from a difference-in-differences logistic regression model and give an estimate of the independent effect of vertical integration on readmissions, based on an odds ratio. Values significantly <1 indicate a reduction of readmissions following vertical integration. Results are presented relative to a control group of hospitals that did not transition to a vertically integrated unit. The period studied is 2004–2013 and the 6 months after vertical integration were excluded ($n \geq 16{,}621$ admissions).

CI indicates confidence interval.

diabetes that aims to integrate the various levels of diabetes management and prevention.[40] It is possible that the organizational design of integrated providers created a context favorable to the adoption of actions in the program, allowing for better results than those achieved by non-integrated providers. We observed that approximately 40% of admissions were from patients over 65 years old (approximately 8% above 85), so it was interesting to observe also a positive impact of vertical integration on the readmission of patients admitted with urinary tract infection. However, the absence of an effect for congestive heart failure patients is reason for concern, due to the high readmission rates observed.

Our study has important implications that should be considered in future developments in vertical integration initiatives. These initiatives would gain from a case study of some providers or conditions showing what aspects of the context were more favorable to the intervention, what specific processes and measures of implementation were put in place and how, and what level of integration was achieved and its relation with the scale of reduction of readmissions. Patients with congestive heart failure are a group to consider, as it is a condition for which no effect was found and initiatives to reduce readmissions have been described.[41] In Portugal, vertical integration lacked traditional incentives to support its development, such as the definition of common performance measures for all levels of care.[39] Instead, different performance measures were adopted at each level, apparently unrelated with each other, creating potential incentives for fragmented focus of care. Therefore, the question remains whether improvements could have been realized in a more coordinated program. Finally, vertical integration was expected to reduce readmissions, but there were many reasons for vertical integration, which aimed to increase efficiency, effectiveness, and population-level outcomes.[15–21] Adding to the fact that the consequences of such a complex intervention cannot be reduced to a binary answer (works/does not work), this study's results do not provide an evaluation of the overall success of the vertical integration experience. Such an evaluation would also require considering other outcomes and the cost-effectiveness of the intervention.

The study's findings must be borne in light of several limitations. Readmissions are focused on the hospitals' perspective, so the viewpoint of primary care was out of the scope of this study. Considering patients' experiences and emergency department use would provide a complementary perspective on the outcomes of vertical integration. Patients' experiences of coordination problems[6] are relevant, and reasons why patients return after discharge are still not clearly understood or addressed.[42] Emergency department visits have a considerable impact on health care use and are disruptive for patients and their families.[43] Another limitation resides in the fact that our results cannot be extrapolated to the 2 integrated units we were not able to include in the study. The limitations of administrative data we used for risk adjustment are well described elsewhere.[44] Despite having accounted for the major risk factors for readmission and considering that readmissions from the control group followed the country's evolution trend, the risk of unmeasured differences remains a weakness of any observational research. Randomized control trials offer promising insights into health services research, but that study design was not feasible in this case.

In summary, our results indicate that merging acute and primary care providers into LHUs was associated with reduced risk of readmission, even though improvements were not found for all institutions or condition-specific groups. These findings suggest that vertical integration can have a positive impact, but there are still challenges to be addressed regarding the success of vertical integration in reducing 30-day hospital readmissions.

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