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LIBERALIZING THE OPENING OF NEW PHARMACIES AND HOSPITALIZATIONS

by Andrea Cintolesi* and Andrea Riganti†

Abstract

The paper explores the impact that legal restrictions on pharmacy licenses have on hospitalizations. We draw on the reform approved in 2012 in Italy, which increased by 8 % the number of pharmacies allowed to operate in the national territory. We set up a regression discontinuity design exploiting monthly data on hospitalizations in the Italian provinces. We find that an 8% increase in the number of pharmacies led to a decrease in medical hospitalizations of 1.1% and in related expenditures of 1.3%. This drop is mainly driven by short hospitalizations of children and elderly individuals. On average, every new pharmacy prevents 17 medical hospitalizations every year. We do not find any impact on our control group of surgical hospitalizations, and we validate the results with a battery of placebo tests. Pharmacies appear to reduce hospitalizations by providing information to people who would otherwise be admitted to hospital; other mechanisms are not supported by the data.

JEL Classification: D45, H51, I10, K20.
Keywords: regulation, pharmacies, license, healthcare expenditures, hospitalizations.
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1 Introduction

The literature generally holds that a more widespread distribution of clinics and medical centres reduces emergency room admissions by decreasing unnecessary visits, suggesting that some hospital services may be replaced with capillary health networks (e.g., Alexander et al., 2019, Lippi Bruni et al., 2016). Similarly, pharmacies play a crucial role as primary medical assistance units that provide medicine and information to treat many diseases, and they guarantee coverage every day of the year at any time without the need for an appointment. In many Western countries, the coverage of pharmacies is hindered by strong limitations placed on the number of pharmacies allowed to operate. Here, we examine the impacts of these limitations on hospitalizations.

There are different reasons to suppose that a more widespread distribution of pharmacies, which reduces the cost of visits and increases access, may affect hospitalizations. First, pharmacies may direct some patients to the hospital when they were not planning to go or suggest that they not go to the hospital as they were planning (*information effect*). Second, patients may decide to go to a pharmacy before going to the hospital as they would do otherwise, eventually avoiding hospitalization due to the services received at the pharmacy (*substitution effect*). Finally, pharmacies may promptly provide drugs and advice to patients with very mild diseases that would have waited otherwise, preventing the worsening of their present conditions and the need for future costly hospitalizations (*prevention effect*).

We identify the impact of limitations placed on the number of pharmacies on hospitalization-related expenditures and hospitalization rates using a reform that increased the number of pharmacies allowed to operate in Italy. The reform mandated a sudden increase of approximately 8% in the number of pharmacies, and it was implemented at different times in different regions between 2015 and 2019. We use monthly data on all hospital discharges that occurred between 2010 and 2019 in any public or private organization within the national territory.[1] We normalize the opening months of the new pharmacies across Italian regions, and we set up a regression-in-time discontinuity design (RDiT).

We focus separately on two types of hospitalizations: medical hospitalizations, which do not require "*significant*" surgical procedures and, due to their characteristics, are the most likely to be treatable in pharmacies, and surgical hospitalizations, which are unlikely to be affected by pharmacies–these were used as a control group. We find that the aforementioned increase in the number of pharmacies reduces public expenditure for medical hospitalizations by 1.3%, that is, approximately 1.6 euros per capita every year, and we do not find any effect on expenditures for the control group of surgical admissions[2]. On average, one new

[1] We exclude only discharges for births and those in the neonatal period. Hospitalizations are also associated with special codes that allow us to derive the associated public expenditure of the central government.

[2] Admittedly, it is possible that fewer hospitalizations translate into higher recall to alternative services such as outpatient visits. Unfortunately we are not able to test this effect as our data do not consent to do so. However, outpatient visits have a much lower cost than hospital admissions.

pharmacy prevents 17 hospitalizations every year: as expected, the average impact of a single pharmacy is rather small, but the overall effect adds up to a significant amount when many new pharmacies are opened. We validate the results with additional analyses. First, we set up a battery of placebo tests in which we suppose that the treatment would have taken place during other months before and after the reform; the results are close to zero and not significant, which shows that they are most likely attributable to the reform. Then, we use the ISTAT survey on daily aspects of life to compute the regional before/after variation in ease of access to pharmacies. We split the regions into two groups according to their variation with respect to the median, and we run the RDiT model on the two separated samples. We find that the effect is driven by areas in which the increase in ease of access to pharmacies is greater, showing that the effect is triggered by the improved accessibility to pharmacies generated by the reform.

We try to shed light on the mechanisms at work using data from Federfarma on drug sales at Italian pharmacies; Federfarma covers approximately 95% of the pharmacies operating in the national territory. We run our RDiT model on the number of prescriptions filled at pharmacies and on the value of total and private expenditures for drugs at pharmacies. We find that the openings of new pharmacies do not increase the aggregate amount and value of drugs sold at pharmacies. Therefore, the results are not driven by a higher consumption of drugs (*substitution effect*). Moreover, the *prevention effect* may work only if the same expense at the pharmacy for more timely treatment would be incurred by the patient before hospitalization in any case. This case, although possible, appears very remote. In conclusion, the fact that spending on drugs does not change seems to indicate that the *information channel* is the most plausible channel. In this respect, another element supports the presence of the *information channel*: our results show that the decline in hospitalizations is concentrated among children and elderly individuals, i.e., age groups for which there are more concerns when certain symptoms arise (due to frailty or inability to accurately report the symptom). It is plausible that pharmacists can address the concerns of family members with some advice and prevent a visit to the hospital. Instead, the hospital has a direct incentive to admit these patients, as it receives reimbursements based on the volume of care it supplies. In addition, the hospital may be very cautious and admit patients with very mild symptoms to avoid the risk of not hospitalizing a patient who then undergoes serious and unexpected complications.

This paper improves upon the literature in two ways. First, we relate the competition rules for pharmacies to hospital admissions, while the relevant literature has focused on the relationship between competition rules and the characteristics of services delivered as prices and typologies until now (Martins and Queirós, 2015; Lluch and Kanavos, 2010; OFT, 2003; Rudholm, 2008; Schaumans and Verboven, 2008; Vogler et al., 2014). Second, in contrast to the use of the sole visits to the emergency room (Hollingsworth, 2014; Martsolf et al., 2017) we explore hospital admissions (which can start with a visit to the emergency room) and suggest that local medical facilities also impact costlier hospital interventions than emergency room visits. To the best of our knowledge, only Alexander et al. (2019) have tracked hospitalizations following a visit to the emergency room.

The rest of the related literature consists of papers on other legal limitations in the pharmacy market and on the relationship between pharmacies and health conditions. The literature on legal limitations considers the liberalization of products that could be directly sold to citizens without a medical prescription (over-the-counter drugs or OTCs), which took place all over Europe during the last two decades, and investigates the presence of price competition (e.g., Moura and Barros, 2020; Stargardt et al., 2007; Pilorge, 2016; Vogler et al., 2006).[3] Interestingly, this literature cannot confirm the predicted drop in OTC prices: among them, Moura and Barros (2020) propose a causal setting and show that OTC liberalization may decrease prices, depending on the ability of entrants to exert competitive pressure on incumbents. Moreover, some papers study the effects of regulation on market integrations and pharmacy mergers (e.g., Anell, 2005; Chen et al., 2020). The body of literature on the relationship between pharmacies and health conditions is large and focuses on specific interventions or screenings that pharmacies may implement. For example, some randomized controlled trials (RCTs) explore the link between information received at pharmacies and the risk factors of coronary heart disease, finding that the advice of pharmacists prevents and reduces these behaviours (Blenkinsopp et al., 2003).[4]

This paper is organized as follows: Section 2 provides information on the institutional background and the reform pertaining to the number of pharmacies in Italy, and Sections 3 and 4 describe the identification strategy and the data used, respectively. Section 5 reports the results, and Section 6 presents conclusions.

2 Licensing for pharmacies and the 2012 reform

2.1 Licensing for pharmacies and hospitalizations

Market regulations that limit competition are meant to address the asymmetric information between sellers and buyers, providing the latter with minimum standards of quality that they are not able to assess by themselves at a welfare cost generated by milder competition. These limitations have consequences that have been largely documented in seminal and recent works.[5] Pharmacies are a prominent example of a regulated market because they face strict

[3]Germany and the United Kingdom allowed for some OTC products to be sold in shops other than pharmacies during the 1990s, and they were followed by Denmark, France, Norway, Hungary, Italy, Poland, Portugal and Sweden with substantially similar liberalization in the 2000s.

[4]For other papers in this stream of literature, see Ayorinde et al. (2013), Czech et al. (2020), Leiva et al. (2001), and Littlewood et al. (2022).

[5]Different works find effects on prices, quantities, spatial choices, firm size, intergenerational mobility, aggregate welfare and innovation, which deliver a wide range of normative and positive implications (e.g., Bertrand, 1883; Cournot, 1838; Hotelling, 1929, 1990; Salop, 1979; Bhagwati, 1970; Delbono and Denicolo, 1991; Mocetti, 2016)

limitations on competition in many Western countries. Moreover, pharmacies could act as health centres useful for quickly obtaining information and distribute prescribed medicines. In this respect, limitations on the number of pharmacies may hinder the territorial coverage of pharmacies, thereby affecting public health and the related expenditures.

Increasing the number of pharmacies may result in higher or lower hospitalization costs and rates for at least three reasons. First, pharmacies correct imprecise signals that patients receive on the severity of their diseases. Indeed, going to a pharmacy for a quick consultation is relatively inexpensive, and a pharmacy may direct some patients to go to the hospital when they were not planning to go or persuade them not to go to the hospital as they were planning (*information effect*). Second, for some diseases, patients may opt to go to pharmacies rather than the hospital as they would do otherwise; moreover, thanks to the pharmacy services they receive, they may avoid hospitalization (*substitution effect*).[6] Finally, patients with minor illness are more likely to go to pharmacies than they are to stay home. A pharmacist may be able to deliver drugs and guidance quickly, preventing sicknesses from worsening and the need for hospitalization (*prevention effect*).

In light of this, whether there are relationships between the number of pharmacy licences, the number of hospitalizations and hospitalization cost is an interesting and important study topic. In the following section, we describe and use a reform that took place in Italy in 2012 and mandated a sudden increase in the number of pharmacies of approximately 8% to shed light on this particular subject.

2.2 Licensing for pharmacies in Italy until 2012

Limitations on the number of pharmacies date back at least to the late Middle Ages, when guilds selected and allowed people into professions, controlling this process based on the quality of individuals' work and organizing lobbying to influence political choices.[7] Currently, limitations on competition often take the form of licences, which are scarce in number or require a thorough test of candidate quality. In Italy, both restrictions are in place: to open a pharmacy, candidates need to obtain a dedicated university degree lasting at least five years, and then participate in a public tender through which new licences are issued.[8]

Italian law regulates the number of pharmacies, setting the maximum number of operating pharmacies in each municipality as a function of its current population.[9] Since the

[6]This becomes plausible also because hospitals have a strong incentive to hospitalize patients, as the reimbursements they receive are based on the quantity of care they supply. In fact, the question of unnecessary hospitalizations and how to reduce them has been debated various times in the Italian parliament

[7]During the 12th century, apothecary shops opened in the largest towns, selling artists' paints and supplies in addition to their usual stock; indeed, pharmacists and artists were organized under the same guild, the Guild of Saint Luke.

[8]Alternatively, a person with the required degree can buy a licence from a pharmacist, which rarely happens because licences are often transmitted to heirs (Mocetti, 2016).

[9]Regional administrations, or the two Autonomous Provinces of Trento and Bolzano for the region of Trentino-Alto Adige, are responsible for the promotion of public calls to ensure that there is an adequate number of pharmacies in each municipality given the population.

1960s, population thresholds have been used to establish the maximum number of pharmacies that can open in a municipality: municipalities above a given threshold may open one pharmacy more than those below it. Population figures are updated every two years, and when the population of a municipality exceeds a threshold, local public tenders assign new openings. In contrast, it is much harder to enforce the law when the population of a municipality falls below a threshold due to the difficulty in deciding which pharmacy should close. As a matter of fact, municipalities that are allowed new pharmacies when their populations exceed a threshold do not close them when the population falls below the threshold.

The second column of Table 1 reports the minimum number of residents required to open a pharmacy in an Italian municipality prior to 2012. The minimum number of residents necessary to open the first pharmacy in a municipality was 2.5 thousand, and an additional licence could be issued for every 5 thousand additional residents for municipalities with 12.5 thousand inhabitants or fewer (small cities). Hence, the first pharmacies opened in municipalities with at least 2.5 thousand inhabitants, the second in municipalities with at least 7.5 thousand inhabitants, and the third in municipalities with 12.5 thousand inhabitants. For municipalities with more than 12.5 thousand residents (large cities), the threshold was set to 14 thousand for the fourth pharmacy and then a further licence was issued for each additional 4 thousand inhabitants).[10]

2.3 The 2012 reform

In January 2012, the Italian government approved a law decree aimed at liberalizing certain markets (e.g., banking, car insurance, energy, newsagents), which became law in March 2012.[11] The new rule did not remove the limitations on the number of pharmacies but substantially lowered the population thresholds: the third column of Table 1 reports the new thresholds valid following the new regulation. The law also reserves to regional or autonomous province administrations certain special permits to places with peculiar needs mostly related to geographical characteristics (e.g., remote mountain towns) or special flows of people (e.g., train stations, airports, shopping centres). During the period of our analysis, other reforms concerning cost containment in the healthcare sector were also approved. We describe the most important of them and discuss their importance in the context of our empirical exercise in Appendix D.

To assign the extra pharmacies to be opened following the new regulation, the law instructed the regions and the two autonomous provinces to carry out a special tender. Notably, several regional tenders imposed stricter geographical location requirements, specifying the submunicipal areas in which the pharmacies had to locate[12]. Those who par-

[10] This is the result of Laws 475/1968 and 362/1991. Before Law 362/1991, the threshold dividing small and large cities was 25 thousand residents instead of 12.5 thousand.

[11] Law 27/2012

[12] This is particularly relevant for large cities and for municipalities with high population densities, for which the exact location of a pharmacy must be chosen from a list of streets

Table 1: Minimum number of inhabitants per municipality required to open a pharmacy

	Before liberalization	After liberalization
1^{st} pharmacy	2,500	1,650
2^{nd} pharmacy	7,500	4,950
3^{rd} pharmacy	12,500	8,250
4^{th} pharmacy	14,000	11,550
one additional pharmacy	every 4,000	every 3,300

Note — This table shows the maximum number of pharmacies allowed to operate in each municipality as a function of population before and after the 2012 liberalization. The liberalization substantially lowered the population thresholds and instructed the regions and the two autonomous provinces to carry out a special tender to approve extra pharmacies according to the new regulation.

ticipated in this special call were ranked, and for each region, a number of pharmacists equal to the number of available places were declared winners of the special call. Following their rankings obtained in the call, the winners were able to choose locations from among the available places following their preferences and subsequently had up to six months to open their pharmacies.[13] The tenders were held at different speeds by the regional administrations, and the actual procedures progressed more slowly than planned: the first pharmacy assigned as a result of the new regulation opened in late 2015, and as of the end of our observational period (December 31st, 2019), some regions had not yet finalized all the assignments[14].

We obtain information on any pharmacies operating in Italy after 2005 with all the relevant information on their municipalities and exact locations, along with the exact day of opening and (eventually) closing from the Ministry of Health.[15] We derive the number of open pharmacies at the end of each month within each province from January 2010 to December 2019: the number of pharmacies operating in the national territory was approximately 17.3 thousand at the end of 2012 and 17.4 thousand as of June 30, 2015, while at the end of our observational period (December 31st, 2019), there were 18.9 thousand open pharmacies, approximately 8% more than the prereform number. Accordingly, before the reform, there were 2.9 pharmacies per 10,000 inhabitants in Italy, and at the end of our observational period, the ratio reached 3.15 pharmacies per 10,000 inhabitants.

The increase in the number of pharmacies covered the entire country: Fig. 1 describes the number of pharmacies per inhabitant in 2014 (the year before the first effective imple-

[13] There are several reasons why a winner may decide not to select a pharmacy, for example, if he/she won in more than one region or if the locations remaining after those who were more highly ranked made their choices were not appealing. Therefore, an iterative procedure was implemented from which the unassigned pharmacies were proposed to nonwinners. As a consequence, compliance with the law is high, albeit not complete, as the least appealing pharmacies could still be unassigned.

[14] In particular, the Autonomous Province of Trento published its tender results in July 2020. We therefore decide to drop this province from the entire analysis. We also decide to drop the smallest Italian region, Molise, as the number of pharmacies that were made available is quite low (15), and the aggregate number of open pharmacies does not change over time

[15] Open data website of the Italian Ministry of Health: `https://www.dati.salute.gov.it/`

mentation of the reform) and in 2019 for all Italian provinces. The prereform pharmacies per inhabitant ratios were heterogeneous across the provinces, ranging between 1.31 and 6.46 pharmacies per 10,000 inhabitants (average: 3.19, s.d.: 0.73 and median: 3.06): this is the result of the heterogeneity in the number of inhabitants in municipalities across the country. The per inhabitant ratio increased in all Italian provinces after the reform, ranging from 1.85 to 6.82 (average equal to 3.46, s.d. 0.70 and median 3.38) and displaying a slightly stronger increase in places with lower prereform levels.[16] Table 7 in Appendix A reports the number of pharmacies opened in each province and the month in which the first assignment of each tender was published.

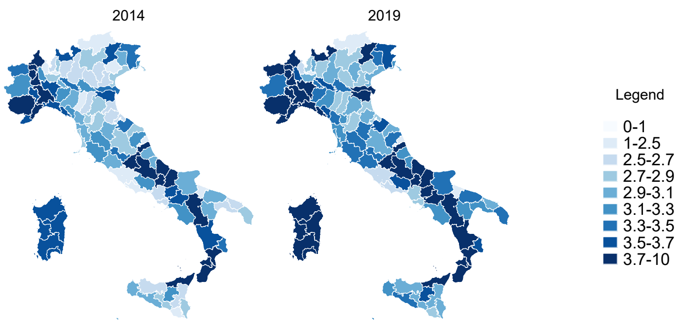

Figure 1: Pharmacies per 10,000 residents in provinces and regions, 2014 and 2019

Note — Source: Italian Ministry of Health. Number of pharmacies per 10,000 residents across Italian provinces in 2014 (immediately before the first regional assignment took place) and in 2019 (at the end of our observational period).

2.4 Location of new pharmacies and increase in accessibility

An increase in the number of pharmacies may impact the ease of access to pharmacies of Italian citizens, depending on their locations and on the coverage of pharmacies preceding the reform.[17]

From a web mapping platform, we scrape the geographical coordinates of pharmacies opened in 2014 and 2019 starting from the addresses contained in the Ministry of Health

[16]This latter fact may also be related to imperfect compliance with the law. Territories in which the law was perfectly implemented before the reform display lower prereform levels than territories in which the law was implemented more loosely (see the beginning of this section). Then, when the liberalization took place, the territories that had more pharmacies than allowed before the reform could open fewer pharmacies than those that had not.

[17]Pharmacies improve accessibility mostly when they cover areas far from existing pharmacies, although their presence close to another pharmacy may still impact accessibility, reducing wait times or improving time coverage.

open data. In Fig. 2, we plot the locations of the new pharmacies on a map of Italy. The figure shows that new openings were widespread throughout the country. The average distance from a new pharmacy to the closest pharmacy is 1.12 kilometres; moreover, considering that the average distance between pharmacies in 2014 was 1.57, the new pharmacies do not appear to be concentrated in areas already covered by other pharmacies.

Figure 2: New and previously opened pharmacies

Note — Source: Italian Ministry of Health. The black dots are pharmacies present as of Dec. 31^{st} 2014, and the green dots are new pharmacies opened before Dec. 31^{st} 2019 as a result of the reform.

Next, we broaden our analysis of the territorial coverage of new pharmacies, including a measure of actual access to pharmacies derived from the ISTAT multipurpose survey on aspects of daily life (AVQ - `https://www.istat.it/en/archivio/129934`). This survey, which is part of an integrated system of social surveys and collects fundamental information on individual and household daily life, is carried out annually on a sample of approximately 50,000 individuals (20,000 households); it inspects, among others, certain issues related to access to healthcare services and facilities, such as pharmacies. The survey is representative at the regional level and spans the entire observational period we consider. Among its questions related to accessibility to services (such as postal offices, municipal offices, schools, and supermarkets), the survey asks whether its interviewees have faced difficulty in accessing pharmacies during the last 12 months. The respondents have three possible choices (they declare no difficulty, some difficulty or much difficulty) or eventually may declare that they do not know the answer. We aggregate those who reported some or much difficulty into a unique category, and we compare this proportion with those who did not report any difficulty in accessing pharmacies. Finally, as the new opening of pharmacies took place at different times for each region, we normalize the time, denoting the last calendar year before the first pharmacy opened in each region as zero, i.e., zero stands for the calendar year that contains the last month before the first pharmacy was opened in each Italian province following the reform. In Fig. 3, we report the share of people corresponding to each degree of difficulty faced in accessing pharmacies over time. For the question about the last 12 months, we expect the impact of the reform to appear gradually in the survey mainly depending on the time of the year when the surveys were conducted and the month in which pharmacies started opening in each province. Fig. 3 shows that during the five years preceding the liberalization, the share of people who did not report any problem in accessing a pharmacy remained steady at approximately 80%, while two years after the reform, this proportion increased to 85%. Conversely, the proportion of respondents who reported some difficulty or much difficulty in accessing pharmacies decreased significantly following the reform. In particular, the share of those who reported at least some difficulty decreased by more than 10 percent (3 percentage points) following the reform, while this level was constant during the previous years. Although the structure of the survey is not suitable to conduct a precise quantitative assessment of the impact of the reform on accessibility, the qualitative conclusions suggest that the reform has increased access to pharmacies.

3 Data on hospitalizations in Italy

The primary focus of our analysis is to estimate the change in hospitalization costs and rates following the liberalization of the pharmacy market. We have access to the Italian national archive of hospital discharges, which is managed by the Ministry of Health and keeps track of any discharge from public or publicly funded hospitals throughout the national territory, excluding only discharges from clinics, nursing homes and psychiatric institutes.

We obtain access to data referring to discharges from acute care in the ordinary regime between January 1st, 2010, and December 31st, 2019.

These data contain detailed information on the personal characteristics of patients, the month of their admission and discharge from hospital, their principal diagnoses, the series of surgical procedures, therapeutic procedures and interventions performed, and whether their discharges followed a *planned* or a *urgent* hospitalization, with the latter almost exclusively coming from emergency rooms (see Table 8).[18] The diagnosis related group (DRG) code is reported for each observation, following the international classification system aimed to group together discharges with similar clinical characteristics that therefore require homogeneous resources. Each DRG is classified into two different groups. The first pertains to whether the hospitalization requires a *surgical* (i.e., that requires a surgeon or a "significant" surgical procedure) or a *medical* (anything else) intervention. The second pertains to the major diagnostic categories (MDCs), an international classification grouping all possible diagnoses.[19] Notably, a crucial contribution of the DRG code is that it allows us to calculate the reimbursement that hospitals and/or local health authorities [20] receive for each

[18]Table 8 shows that 93% of the urgent medical hospitalizations come from emergency rooms and that 90% of the urgent surgical hospitalizations come from emergency rooms. The remaining hospitalizations are of patients sent to the hospital upon a medical referral, that is, hospitalizations that were planned by the hospital and anticipated or transferred from other institutions.

[19]Overall, there are twenty-five MDCs.

[20]The responsibility for the organization of the provision of healthcare services is given to regions, which can choose to allow hospitals to operate as independent hospital trusts or act as providers depending on local health authorities.

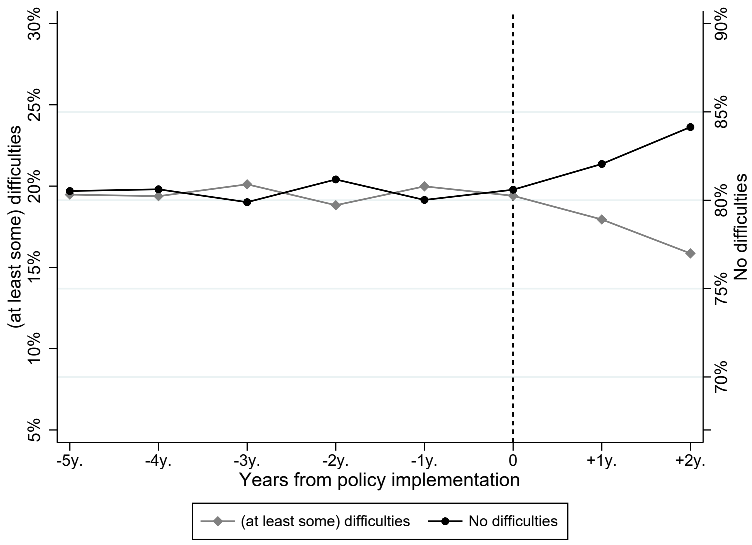

Figure 3: Accessibility to pharmacies

Note — Our elaboration on the daily life data from the ISTAT survey regarding the share of people who report no difficulty as opposed to those who report at least some difficulty in accessing pharmacies by year across the Italian territory. For each region, we normalize the year of the first opening of a pharmacy to zero as a consequence of the new rules.

hospitalization.

We focus on the five MDCs with relatively high expenditure volume over the time span considered, namely, diseases related to the nervous (MDC-01), respiratory (MDC-04), circulatory (MDC-05), digestive (MDC-06) and musculoskeletal (MDC-08) systems. These account for approximately two-thirds of total government expenditure; moreover, we aggregate the remaining specialities into a unique residual category. Table 2 reports the average expenditure per 1,000 residents[21] for each considered MDC, reporting by urgency level and by the presence of surgical interventions, over the twelve months before and after the last month before the first pharmacy openings. Details on expenditures for the remaining specialities are provided in Table 9 in Appendix C, while details on expenditures throughout the entire 2010-2019 period are provided in Table 10 Appendix C.

Overall, more than one-third of total expenditures are for urgent nonsurgical hospitalizations, and another one-third correspond to planned surgical interventions. The more expensive category refers to diagnoses and diseases pertaining to the *cardiocirculatory* system, for which only a small fraction of the total expenditure is devoted to planned nonsurgical interventions, while the three remaining combinations are quite similar in terms of expenditure. Diagnoses and diseases pertaining to the *musculoskeletal system and connective tissue* and to the *digestive* system are two families of interventions with remarkably higher fractions of expenditures devoted to surgical interventions, both for planned or emergency admissions rather than nonsurgical ones. Expenditures for diseases pertaining to the *respiratory* system mainly fall into urgent-nonsurgical interventions, and the same applies to those of the *nervous* system.

4 Identification

We seek to investigate the consequences of an increase in the number of pharmacies per inhabitant on public expenditures pertaining to hospitalizations. The liberalization described in Section 2 offers a unique opportunity to address this paper's question thanks to the sudden increase in the number of pharmacies at the time of the first round of assignment: a government decision mandated an increase in the number of licences for pharmacies available throughout the country, and the winners of public tenders could open new pharmacies within six months within very small territories.

As the speed of a tender is related to bureaucratic procedures, the time that it takes to assign pharmacies to candidates is largely exogenous to the expenditure for hospitalizations. Furthermore, we observe that most of the new pharmacies opened during the sixth month after the publication of the assignments: this is probably due to the bureaucratic and practical procedures related to initiating new economic activities (finding a location, hiring

[21]The Italian residential population utilized is that calculated as of the 2011 census, which is retrieved from the Italian National Institute of Statistics (ISTAT).

Table 2: Average monthly spending in euros per 1,000 residents ± 12 months from the month prior to the first pharmacy opening

	Medical Discharges			*Surgical discharges*		
	Overall	Planned	Urgent	Overall	Planned	Urgent
Expenditures	9,805	1,534	8,270	13,360	7,582	5,778
	(2092)	(586)	(1958)	(2875)	(2297)	(944)
Nervous	1,304	157	1,147	759	365	394
	(337)	(105)	(301)	(213)	(136)	(136)
Respiratory	2,389	211	2,178	342	238	105
	(721)	(122)	(726)	(122)	(91)	(60)
Cardiocirculatory	1,518	209	1,309	3,493	1,657	1,836
	(397)	(107)	(355)	(933)	(673)	(429)
Digestive	717	93	624	1,609	761	848
	(206)	(56)	(181)	(389)	(256)	(201)
Musculoskeletal	252	69	183	3,256	1,675	1,581
	(84)	(42)	(70)	(946)	(758)	(356)
Other	3,625	796	2,829	3,901	2,886	1,015
	(802)	(285)	(728)	(890)	(801)	(231)
n obs.	2,300	2,300	2,300	2,300	2,300	2,300

Source: Italian Ministry of Health. Average spending between twelve months before and after the first pharmacy openings per 1,000 residents in euros per MDC.

personnel, etc.). In this respect, the timing of the opening of the new pharmacies is also likely to be exogenous to expenditures for hospitalizations.

We implement a regression discontinuity-in-time (RDiT) design. RDiT is a quasi-experimental technique designed to measure the effect of a treatment by comparing the dependent variable immediately prior to the moment of treatment and immediately after it. While the spirit of RDiT is similar to that of the standard regression discontinuity design (RDD), the RDiT design does not exploit cross-sectional variation in treatment status as standard RDD does. Instead, it makes use of the time variation in the treatment status of provinces: by comparing the observations lying near the threshold and assuming that confounding factors do not change discontinuously between the month immediately preceding the treatment and the month immediately following, it is possible to isolate the desired treatment effect. Our study, using monthly data, implements this design using the time of the opening of a group of pharmacies in a given province as a treatment dummy. In our case, the assumption that identifies the effect is that confounding factors do not change discontinuously exactly in conjunction with the treatment. [22]

Because the increase in the number of pharmacies per inhabitant takes place at a different time in each region, we normalize the time to the first month in which the increase takes place. For province p, opening month m and calendar month c:

$$y_{pmc} = \alpha_0 + \alpha_1 \text{post}_m + f(\text{month}_m) + \phi_p + \eta_c + \epsilon_{pmc} \quad (1)$$

where y_{pmc} denotes public expenditures for hospitalizations, i.e., our outcome of interest; post_m is a dummy taking a value of 1 for months after the treatment; ϕ_p is province fixed effects; η_c is calendar month fixed effects and $f(\text{month}_m)$ is a time trend allowed to be different before and after the reform. Our coefficient of interest is α_1, which identifies the discontinuous change in y_{pmc} at the time of the treatment.

An alternative methodology would exploit the staggered introduction of the policy across regions in a difference-in-differences setting. However, there are two important drawbacks that do not allow for this implementation. First, many regions completed the first round of assignment between March 2016 and July 2017, which makes the variations in the time of treatment very limited. Second and most importantly, different regions present different trends even before the reform, violating the basic difference-in-differences identifying assumption. Finally, it would be tempting and admittedly ideal to think of an RDD strategy at the municipal level exploiting population thresholds. Indeed, two papers have already exploited this variation for different research questions (Calzolari et al., 2018; Mocetti, 2016); however, unfortunately, we were not granted access to data on hospital discharges at the municipal level, which made it impossible to implement this strategy in our framework.

5 Results

5.1 Main results

Table 3 reports the results of specification Eq. (1) on government expenditures. In our most preferred specification, we cluster standard errors at the regional level and assume the time trend to be quadratic; in Appendix E, we check the robustness of our results to alternative functional forms. We find that the increase in the number of pharmacies reduces government expenditure for medical hospitalizations by 1.3 percent. Interestingly, columns 2 and 3 of Table 3 show that the increase in the number of pharmacies reduces urgent (-1.5%) rather than planned hospitalizations (-0.7%). These results show that limitations on the number of pharmacies have important spillovers onto government expenditures. As shown in Table 10, the average monthly expenditure for medical discharges over our entire observational period per 1,000 residents is slightly above 10 thousand euros, resulting in an

[22] See Hausman and Rapson (2018) for a comparison between RDiT with RDD and with event studies.

annual per capita expenditure of 120.66 euros; as a consequence, we estimate savings equal to 1.57 euros per capita per year, which amounts to a total of slightly more than 90 million euros per year.

We corroborate the results by running the same specification for expenditures related to a control group made up of surgical admissions and with a battery of placebo tests. Table 3 shows that expenditures for surgical admissions, which are unlikely to be treated with drugs sold at pharmacies, do not change in conjunction with the increase in the number of pharmacies. Then, we run specification Eq. (1) on expenditures for medical admissions while falsifying the month of treatment (we set the time of the treatment to six months after the true month of treatment or six, twelve and eighteen months before it). Table 3 reports the obtained coefficients, which are not significant and closer to zero than the main estimates, vouching for the fact that the results are driven by the reform we are analysing.

As a possible caveat, note that the RDiT is meant to measure the instantaneous impact of the new policy, therefore providing evidence on short-term effects. Possible long-term consequences, which may offset and revert these results, are not part of this analysis, and we leave this issue to further research.

5.2 Results for specialities and hospitalisation rate

Table 4 shows the results regarding expenditure across the main medical specialities and evaluates whether the reduction in expenditures for medical hospitalizations is driven by a decrease in hospitalizations. Panel a) shows the results regarding medical specialities, revealing that the effect on expenditures for medical hospitalizations is heterogeneous across specialities. Expenditures for medical hospitalizations related to diseases pertaining to the *nervous*, *digestive* and *musculo-skeletal* systems decrease by 3.2, 3.6 and 5.8 percentage points, respectively. The effect on expenditures associated with *respiratory* system diseases is negative but lacks statistical significance. Instead, expenditures for medical hospitalizations pertaining to the *cardiocirculatory* system diseases do not decrease. Finally, expenditures for *other* hospitalizations decrease by 2.2 percentage points. Again, columns 2 and 3 of Table 4 show that the effects are strong and significant for only urgent medical hospitalizations.

Panel b) studies whether the decrease in public expenditures for medical hospitalizations is driven by a decrease in admissions. This analysis may shed light on whether pharmacies are a complete substitute for hospitals or whether they simply shorten patients' stays at the hospital. Indeed, an increase in pharmacies makes medicine more available, and patients may receive treatments that prevent the need for a hospital stay (*substituability effect*). However, pharmacies may also shorten patients' stays at hospitals, improving their condition upon arrival, or acting as a primary unit of information that directs patients to hospitals sooner than they would otherwise go (*prevention effect* and *information effect*).

We run specification Eq. (1) on the hospitalization rate per inhabitant, and we find that

Table 3: Expenditure - main estimates

	Overall	Planned	Urgent
Expenditure for medical hospit.			
month of the treatment	-0.013**	-0.007	-0.015**
	(0.006)	(0.014)	(0.007)
Expenditure for surgical hospit.			
month of the treatment	-0.011	-0.017	-0.003
	(0.008)	(0.012)	(0.011)
Expenditure for medical hospit.: placebos			
six months later	-0.004	-0.006	-0.004
	(0.006)	(0.017)	(0.007)
six months before	-0.005	-0.023	-0.001
	(0.006)	(0.014)	(0.007)
twelve months before	-0.006	-0.013	-0.003
	(0.006)	(0.015)	(0.007)
eighteen months before	-0.002	0.010	-0.004
	(0.006)	(0.012)	(0.007)

Note — $^{**}p < 0.05$. Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of government expenditure (model: $y_{pmc} = \alpha_0 + \alpha_1 \text{post}_m + f(\text{month}_m) + \phi_p + \eta_c + \epsilon_{pmc}$). We assume a quadratic polynomial allowed to differ on either side of the threshold. We report in order the main estimates of medical hospitalizations, the main estimates of the control group of surgical hospitalizations, and the placebos for medical hospitalizations. The placebos falsify the month of treatment: we suppose that the treatment took place six months after the true month of treatment or six, twelve and eighteen months before it. Overall, none of the placebo estimates is significantly different from zero or close in magnitude to the main results, which shows that the results are driven by the reform we are analysing.

the number of medical hospitalizations drops by 1.1% with the reform. This drop is driven by urgent as opposed to planned medical hospitalizations, supporting the results regarding expenditures in Table 3.

5.3 Size of the results and accessibility

The fact that the opening of new pharmacies reduced expenditures for medical hospitalizations by 1.3 percent is quite surprising and may eventually raise the question of how realistic it can be to conclude that new pharmacies can have this impact. Here, we briefly

Table 4: Specialties and number and length of admissions

	Medical	Medical Planned	Medical Urgent	Surgical	Surgical planned	Surgical Urgent
a) Specialties						
Nervous						
	-0.032***	0.012	-0.041***	-0.005	-0.001	-0.000
	(0.011)	(0.032)	(0.013)	(0.026)	(0.039)	(0.062)
Respiratory						
	-0.009	0.031	-0.013	0.009	0.104	-0.053
	(0.013)	(0.062)	(0.014)	(0.051)	(0.100)	(0.298)
Cardiocirculatory						
	0.011	0.018	0.009	-0.014	-0.044*	0.011
	(0.013)	(0.031)	(0.015)	(0.014)	(0.024)	(0.017)
Digestive						
	-0.036*	-0.090	-0.030*	-0.003	-0.005	-0.007
	(0.018)	(0.070)	(0.018)	(0.020)	(0.027)	(0.028)
Muscolo-skeletal						
	-0.058*	-0.025	-0.065*	-0.010	-0.017	-0.006
	(0.030)	(0.067)	(0.035)	(0.010)	(0.020)	(0.013)
Other						
	-0.022**	-0.015	-0.019**	-0.014	-0.015	-0.005
	(0.009)	(0.020)	(0.009)	(0.014)	(0.016)	(0.026)
b) Number of medical admissions						
Number of hospitalizations	-0.011*	-0.008	-0.011*	-0.002	-0.002	-0.000
	(0.006)	(0.013)	(0.007)	(0.008)	(0.013)	(0.009)

Note — $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$. Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of government expenditure (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$). We assume a quadratic polynomial allowed to differ on either side of the threshold. In Panel (a), we report the estimates for hospitalizations for selected specialities, for the medical treatment group and for the surgical control group, both for planned and urgent hospitalisations. In Panel (b), we report the results of specification Eq. (1) regarding the hospitalization rate (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$). We assume a quadratic polynomial allowed to differ on either side of the threshold.

show that the effect is reliable. In Italy, there are 3.86 monthly medical hospitalizations per 1,000 residents (Table 13); therefore, a reduction of 1.1 percent corresponds to approximately 2,500 fewer hospitalizations each month. Given that the number of new pharmacies is slightly below 1,500, one new pharmacy prevents 1.7 people from being hospitalized each month. Considering the high turnout at pharmacies, we believe that this effect is largely reliable: the effect of a single pharmacy is rather small, but because there are many new openings, the aggregate effect adds up to a sizeable result.

We corroborate these results with a robustness exercise that exploits the heterogeneity in the intensity of the treatment. According to the ISTAT survey illustrated in Section 2.4, the ease of access to pharmacies increases more in some regions and less in others. Hence, if the effect is driven by improved access to pharmacies, it should be stronger in areas in which this access increases more. We compute the regional variation in the selfreported ease of access of residents in the year that contains the last month before the first pharmacy was opened in each Italian province following the reform and the following year, and we separate provinces into two groups depending on their position with respect to the median variation in the region to which they belong. Then, we run specification Eq. (1) separately for those above the median and those below it. The results in Table 5 show that regions that display higher variation decrease the expenditures for medical admissions to their hospitals by 2.4%, with a heterogeneous effect across different specialties. Conversely, provinces below the median display a much lower and nonsignificant coefficient. Hence, the reduction in expenditures for medical hospitalizations is driven entirely by areas in which accessibility increases the most.

Table 5: Heterogeneous effect in the variation in ease of access to pharmacies

	Overall	*Nervous*	*Respiratory*	*Cardiocirculatory*	*Digestive*	*Musculoskeletal*	*Other*
Δ accessibility: above and below median change after 1 year							
Above median	-0.024***	-0.054***	-0.041***	0.019	-0.022	-0.086**	-0.022**
	(0.008)	(0.028)	(0.016)	(0.017)	(0.021)	(0.037)	(0.011)
Below median	-0.007	-0.029**	0.011	0.000	-0.037*	-0.046	-0.016
	(0.009)	(0.015)	(0.015)	(0.017)	(0.019)	(0.037)	(0.010)

Note — $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$. Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of government expenditure (model: $y_{pm} = \alpha_0 + \alpha_1 \mathrm{post_m} + \alpha_2 \mathrm{above}_p \cdot \mathrm{post_m} + f(\mathrm{month_m}) + \phi_p + \eta_m + \epsilon_{pm}$) both for provinces located in regions that experienced a change in accessibility above and below the median change. We report the main estimates of urgent medical hospitalizations. We assume a quadratic polynomial allowed to differ on either side of the threshold.

5.4 Length of hospitalization and patient's age

In Fig. 4, we plot the distribution of hospitalizations against the length of stay in a hospital. The figure shows that the lower level of the urgent hospitalization rate following the reform is entirely driven by the shortest hospitalizations, while the two rates are equal when conditioning on longer stays[23]. Conversely, the distributions of hospitalization rates before

[23]In Table 14 we also show that the effect is driven by hospitalisation that resolved in a discharge at home or in sub-acute structures, as opposed to those who ended up with patient's death, confirming the fact that the policy had a greater effect for milder hospitalisations

and after the treatment are very similar for planned hospitalizations (and for planned and surgical hospitalizations; see Fig. 8). Because the shortest medical hospitalizations are also the mildest ones, the findings in Fig. 4 are in line with the possibility that pharmacies are a plausible substitute for hospital admissions for mild diseases. In Fig. 5, we also added the patient's age. The decline in medical hospitalizations is driven by short-term hospitalizations of children and elderly individuals. A plausible explanation for this phenomenon is that doctors are more cautious with more fragile individuals, who are subject to greater uncertainty about the evolution of their symptoms or who are unable to objectively report symptoms. The figure again confirms that surgical hospitalizations do not change, even when different ages and duration levels are explored.

5.5 Drug use, drug poisoning and type of first diagnosis

Then, we explore whether drug use varies. We use data from Federfarma from 2014 to 2017, which covers 95% of the universe of pharmacies. These data contain monthly information for each province on the number of prescriptions and the expenditures for drugs pertaining to each treatment category. This analysis may shed light on whether it is the use of drugs (*substitution effect*) that prevents the decrease in hospitalizations that drives the decline in our main results. Table 6 shows the results of our main model on the number of prescriptions used at pharmacies, on drug expenditures and on private drug expenditures. Neither the number of prescriptions nor the expenditures (total or private) change with the opening of new pharmacies. Using the ATC code classification (a unique code assigned to a medicine according to the organ or system it affects and how it works), we also run the model for categories of drugs. Overall, the coefficients are slightly negative and not significant, even for categories associated with pathologies for which medical hospitalizations are decreasing. Therefore, the reduction in medical hospitalizations is not attributable to an increase in the consumption of drugs: this suggests that the substitution channel may not drive the results. Moreover, the prevention effect may work only if the same expense at the pharmacy for more timely treatments would be incurred by the patient before being hospitalized in any case. This case, although possible, appears very remote. In conclusion, the fact that spending on drugs does not change seems to indicate that the information channel is the most plausible channel.

We corroborate our analysis on drug consumption by studying whether drug poisoning varies. This could be possible in the event that pharmacists push themselves to treat diseases for which they do not have adequate skills. Table 20 shows that the number, expenditures and length of drug poisoning hospitalizations remain the same with the opening of the new pharmacies. More widespread pharmacy coverage does not seem to be associated with the excessive or incorrect use of drugs.

Finally, we explore other type of information available to us in the ministerial data: the first diagnosis made upon each hospitalization. This diagnosis is temporary and to be verified and is made to direct the initial inspections toward a more complete and final diagnosis. Using our RDiT model for each diagnosis, in Fig. 6, we see that the decline in hospitalizations is concentrated in two general and, to some extent, residual categories, the category of injury and poisoning and the category of symptoms, signs and ill-defined conditions.

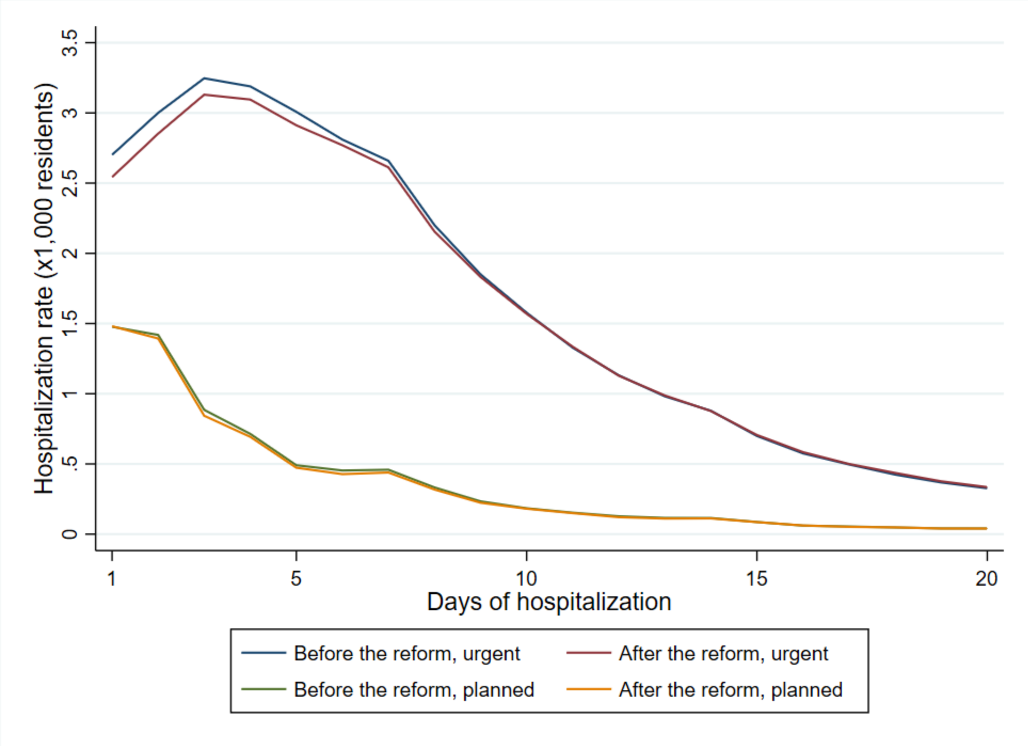

Figure 4: Length of medical hospitalizations

Note — Our elaboration on the Ministry of Health data. We plot the hospitalization rates for planned and urgent medical discharges in the 12 months preceding/following the opening of the first pharmacy, conditioning on days of hospitalization.

6 Conclusions

Limitations on market competition may have specific spillovers depending on market characteristics. In this paper, we study whether extending the number of pharmacies, which offer important services that can improve the health of the population, impacts public expenditures for hospitalizations.

Italy has a pharmacy per inhabitant ratio very close to the European average (Fig. 7) and offers a suitable opportunity to answer this paper's question with the increase in the number of pharmacies in Italy resulting from Law 27/2012. This law mandated the opening of pharmacies, resulting in approximately an 8% increase in the number of pharmacies with respect to the number present at the time of the reform. The openings took place a few months after the completion of the public tender. We use data from the Ministry of Health

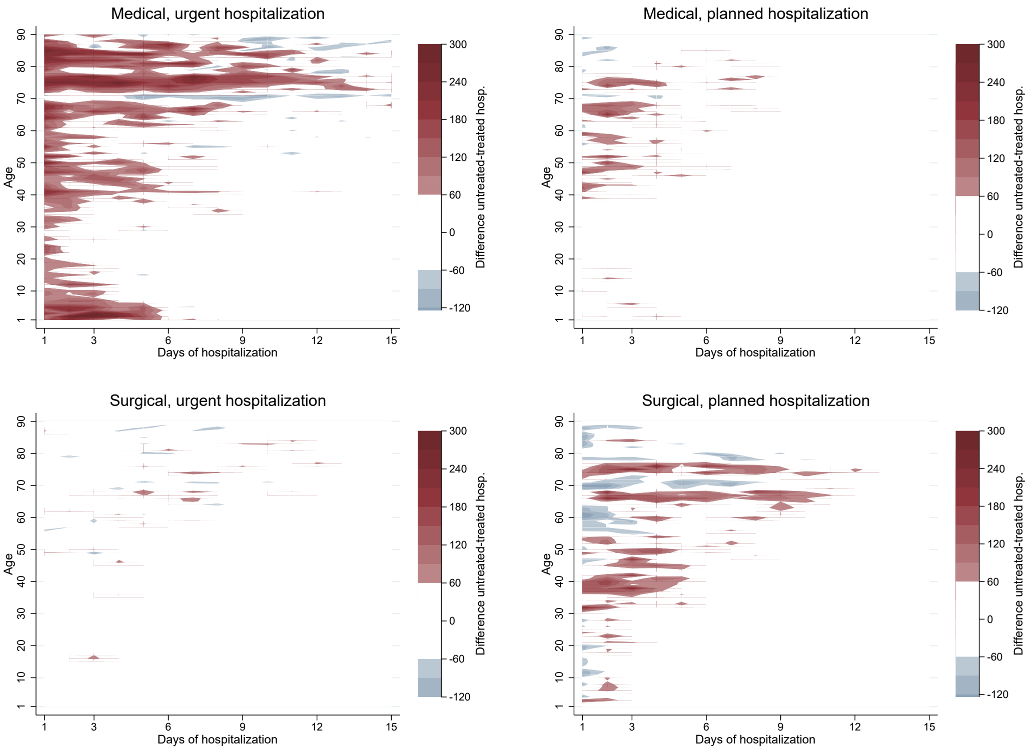

Figure 5: Length of medical hospitalizations

Note — Our elaboration on the Ministry of Health data. We plot the difference in the average hospitalization rates in the 12 months preceding/following the treatment for planned and urgent medical and surgical discharges, conditioning on days of hospitalization and age.

on expenditures for hospitalizations, and we find that increasing the number of pharmacies decreases the public expenditure for hospitalizations. Overall, the reform decreased medical hospitalizations by approximately 25.5 thousand (17 fewer hospitalizations for every new pharmacy), allowing the Italian central government to spend approximately 90 million euros less on medical hospitalizations every year (the average cost of a medical hospitalization is 3.5 thousand euros). These results are driven by a reduction in the expenditures for medical hospitalizations and are null for a control group of surgical hospitalizations, which are more complex and are less treatable at pharmacies. We provide evidence that the reduction in public expenditure originates from fewer hospitalizations, and we argue that health conditions and aggregate spending benefit from an increased number of open pharmacies.

The results of this paper may be relevant for shaping institutions that regulate the market for pharmacies. While much attention has been devoted to the effects of the focal liberalization on OTC products, we show that increasing the number of pharmacies generates welfare gains arising from better health conditions and decreased aggregate spending. In this respect, a higher number of pharmacies, conditional on standards of quality that in many countries are assessed separately through specific exams for pharmacists, seems

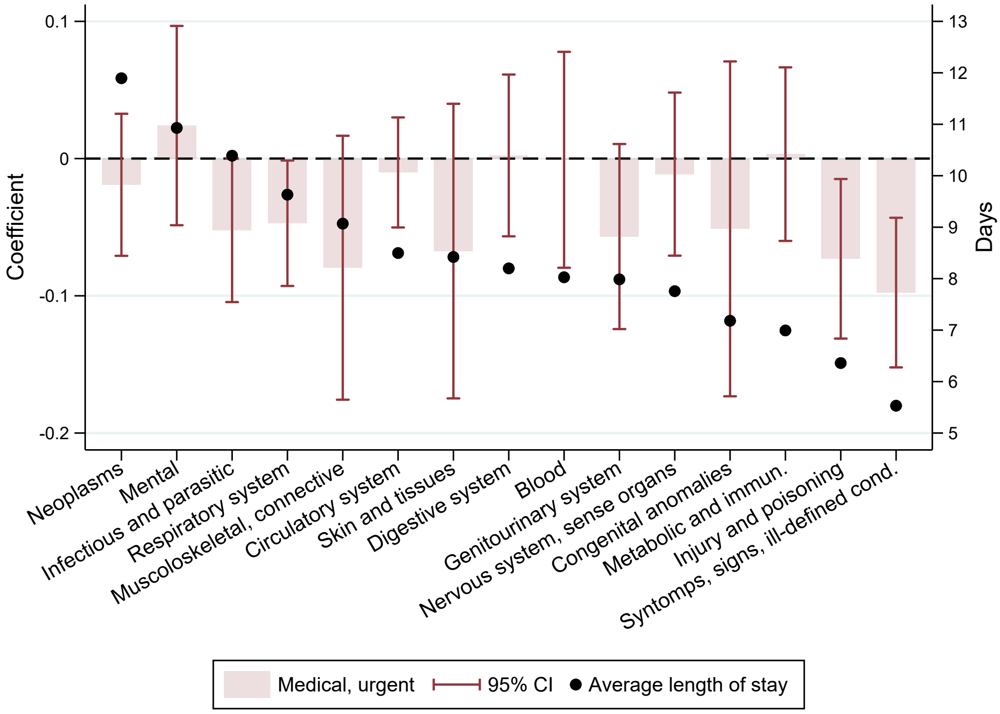

Figure 6: Results per first diagnosis at arrival

Note — Our elaboration on the Ministry of Health data. Standard errors are clustered at the regional level. The results for specification Eq. (1) use the log of admissions depending on the diagnosis at arrival (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + \alpha_2 \text{above}_p \cdot \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$). The pink bars are the coefficient of interest, and the red lines represent the 95% confidence interval s. The black dots are the average length of hospitalizations (right axis) depending on the diagnosis at arrival immediately before the opening of new pharmacies.

desirable. However, care should be taken in generalizing these results to different contexts; for example, health systems of a different quality may undermine the external validity of the results. Additionally, this paper's results are likely to be nonlinear in relation to the prereform number of pharmacies, meaning that a marginal increase may have a stronger or milder effect depending on how many pharmacies were previously operating.

Table 6: Expenditures for medicines at pharmacies

	prescriptions	packages	expenditure	private expenditure
Total	-0.011	-0.010	-0.012	-0.008
	(0.009)	(0.009)	(0.008)	(0.010)
A: Alimentary tract and metabolism	-0.009	-0.009	-0.002	-0.007
	(0.009)	(0.009)	(0.010)	(0.013)
B: Blood and blood forming organs	-0.015	-0.014	-0.025	-0.033
	(0.014)	(0.014)	(0.016)	(0.024)
C: Cardiovascular system	-0.007	-0.008	-0.011	-0.003
	(0.008)	(0.008)	(0.009)	(0.011)
D: Dermatologicals	-0.007	-0.008	0.015	-0.018
	(0.011)	(0.011)	(0.016)	(0.016)
G: Genito urinary syst. and sex horm,	-0.005	-0.006	-0.039***	0.020*
	(0.007)	(0.007)	(0.012)	(0.011)
H: Systemic hormonal preparations	-0.022	-0.026	-0.022	-0.036**
	(0.015)	(0.016)	(0.022)	(0.018)
J: Antinfective for systemic use	-0.004	-0.005	-0.004	-0.019
	(0.012)	(0.012)	(0.012)	(0.015)
L: Antineoplastic and immunomod. ag.	0.004	0.004	0.017	0.007
	(0.011)	(0.011)	(0.014)	(0.029)
M: Muscolo-skeletal system	-0.008	-0.007	-0.008	0.008
	(0.011)	(0.011)	(0.010)	(0.014)
N: Nervous system	-0.010	-0.008	-0.018**	-0.004
	(0.008)	(0.008)	(0.008)	(0.013)
P: Antiparasitic products,	0.014	0.010	0.007	0.028
insecticides and repellents	(0.015)	(0.016)	(0.017)	(0.019)
R: Respiratory system	-0.034**	-0.033**	-0.028**	-0.031
	(0.016)	(0.015)	(0.011)	(0.019)
S: Sensory organs	-0.017*	-0.018*	-0.031**	-0.015
	(0.010)	(0.010)	(0.013)	(0.019)
V: Various	-0.008	-0.023	-0.012	-0.092
	(0.020)	(0.029)	(0.024)	(0.070)
Obs	2,275	2,275	2,275	2,275

Note — $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Our elaboration on Federfarma data. Standard errors clustered at the regional level are in parentheses. The categories from A to V are the first level of ATC codes (click for more information). Level H excludes sex hormones and insulins. Results of specification Eq. (1) use the log of drugs sold, packages sold and total and private expenditures (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + \alpha_2 \text{above}_p \cdot \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$). With respect to main specification, we drop one province from the analysis, as data on drugs were not available.

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A Details on pharmacy openings

Regions above the median before/after variation in accessibility used in Fig. 3. Below: Abruzzo, Calabria, Campania, Emilia-Romagna, Friuli Venezia Giulia, Liguria, Lombardia, Marche, Umbria, Valle d'Aosta. Above: Basilicata, P.A. Bolzano, Piemonte, Puglia, Sardegna, Sicilia, Toscana, Veneto. The variation in accessibility is available at the regional (or autonomous province) level. This grouping splits the provinces into two groups of equal numbers (46) above and below the median.

Table 7: New pharmacies and date of first assignment for Italian provinces

Region	Province	New pharmacies	Date of publication of 1st assignment ranking	Region	Province	New pharmacies	Date of publication of 1st assignment ranking
PIEMONTE	ALESSANDRIA	10	Jul-15	UMBRIA	PERUGIA	31	Jun-18
PIEMONTE	ASTI	9	Jul-15	UMBRIA	TERNI	8	Jun-18
PIEMONTE	BIELLA	6	Jul-15	MARCHE	ANCONA	22	Apr-16
PIEMONTE	CUNEO	32	Jul-15	MARCHE	ASCOLI PICENO	5	Apr-16
PIEMONTE	NOVARA	17	Jul-15	MARCHE	FERMO	5	Apr-16
PIEMONTE	TORINO	63	Jul-15	MARCHE	MACERATA	13	Apr-16
PIEMONTE	VERBANO-CUSIO-OSSOLA	4	Jul-15	MARCHE	PESARO E URBINO	17	Apr-16
PIEMONTE	VERCELLI	6	Jul-15	LAZIO	FROSINONE	20	May-16
VALLE D'AOSTA	AOSTA	2	Nov-15	LAZIO	LATINA	30	May-16
LOMBARDIA	BERGAMO	75	Mar-17	LAZIO	RIETI	7	May-16
LOMBARDIA	BRESCIA	40	Mar-17	LAZIO	ROMA	206	May-16
LOMBARDIA	COMO	13	Mar-17	LAZIO	VITERBO	11	May-16
LOMBARDIA	CREMONA	7	Mar-17	ABRUZZO	CHIETI	22	Jan-18
LOMBARDIA	LECCO	10	Mar-17	ABRUZZO	L'AQUILA	27	Jan-18
LOMBARDIA	LODI	10	Mar-17	ABRUZZO	PESCARA	20	Jan-18
LOMBARDIA	MANTOVA	7	Mar-17	ABRUZZO	TERAMO	16	Jan-18
LOMBARDIA	MILANO	87	Mar-17	MOLISE	CAMPOBASSO	7	Jul-18
LOMBARDIA	MONZA E DELLA BRIANZA	52	Mar-17	MOLISE	ISERNIA	8	Jul-18
LOMBARDIA	PAVIA	7	Mar-17	CAMPANIA	AVELLINO	12	Feb-17
LOMBARDIA	SONDRIO	2	Mar-17	CAMPANIA	BENEVENTO	8	Feb-17
LOMBARDIA	VARESE	33	Mar-17	CAMPANIA	CASERTA	42	Feb-17
TRENTINO-ALTO ADIGE	BOLZANO	20	May-17	CAMPANIA	NAPOLI	100	Feb-17
TRENTINO-ALTO ADIGE	TRENTO	16	Jul-20	CAMPANIA	SALERNO	47	Feb-17
VENETO	BELLUNO	9	Mar-16	PUGLIA	BARI	59	Apr-16
VENETO	PADOVA	42	Mar-16	PUGLIA	BARLETTA-ANDRIA-TRANI	21	Apr-16
VENETO	ROVIGO	5	Mar-16	PUGLIA	BRINDISI	19	Apr-16
VENETO	TREVISO	53	Mar-16	PUGLIA	FOGGIA	23	Apr-16
VENETO	VENEZIA	28	Mar-16	PUGLIA	LECCE	41	Apr-16
VENETO	VERONA	41	Mar-16	PUGLIA	TARANTO	25	Apr-16
VENETO	VICENZA	46	Mar-16	BASILICATA	MATERA	12	May-17
FRIULI-VENEZIA GIULIA	GORIZIA	4	Sep-16	BASILICATA	POTENZA	14	May-17
FRIULI-VENEZIA GIULIA	PORDENONE	18	Sep-16	CALABRIA	CATANZARO	16	Jul-17
FRIULI-VENEZIA GIULIA	TRIESTE	4	Sep-16	CALABRIA	COSENZA	33	Jul-17
FRIULI-VENEZIA GIULIA	UDINE	23	Sep-16	CALABRIA	CROTONE	8	Jul-17
LIGURIA	GENOVA	20	Apr-15	CALABRIA	REGGIO DI CALABRIA	26	Jul-17
LIGURIA	IMPERIA	37	Apr-15	CALABRIA	VIBO VALENTIA	8	Jul-17
LIGURIA	LA SPEZIA	10	Apr-15	SICILIA	AGRIGENTO	16	Jan-18
LIGURIA	SAVONA	22	Apr-15	SICILIA	CALTANISSETTA	9	Jan-18
EMILIA-ROMAGNA	BOLOGNA	35	May-16	SICILIA	CATANIA	48	Jan-18
EMILIA-ROMAGNA	FERRARA	3	May-16	SICILIA	ENNA	2	Jan-18
EMILIA-ROMAGNA	FORLI-CESENA	18	May-16	SICILIA	MESSINA	19	Jan-18
EMILIA-ROMAGNA	MODENA	27	May-16	SICILIA	PALERMO	73	Jan-18
EMILIA-ROMAGNA	PARMA	22	May-16	SICILIA	RAGUSA	21	Jan-18
EMILIA-ROMAGNA	PIACENZA	11	May-16	SICILIA	SIRACUSA	17	Jan-18
EMILIA-ROMAGNA	RAVENNA	15	May-16	SICILIA	TRAPANI	17	Jan-18
EMILIA-ROMAGNA	REGGIO NELL'EMILIA	29	May-16	SARDEGNA	CAGLIARI	23	Apr-18
EMILIA-ROMAGNA	RIMINI	18	May-16	SARDEGNA	CARBONIA-IGLESIAS	4	Apr-18
TOSCANA	AREZZO	13	Jun-15	SARDEGNA	MEDIO CAMPIDANO	10	Apr-18
TOSCANA	FIRENZE	27	Jun-15	SARDEGNA	NUORO	4	Apr-18
TOSCANA	GROSSETO	5	Jun-15	SARDEGNA	OGLIASTRA	2	Apr-18
TOSCANA	LIVORNO	14	Jun-15	SARDEGNA	OLBIA-TEMPIO	10	Apr-18
TOSCANA	LUCCA	13	Jun-15	SARDEGNA	ORISTANO	19	Apr-18
TOSCANA	MASSA-CARRARA	5	Jun-15	SARDEGNA	SASSARI	18	Apr-18
TOSCANA	PISA	16	Jun-15	SARDEGNA	SUD SARDEGNA	-	Apr-18
TOSCANA	PISTOIA	14	Jun-15				
TOSCANA	PRATO	16	Jun-15				
TOSCANA	SIENA	8	Jun-15				

Note — Source: our own elaboration from the official regional calls for new openings and from the official lists of first assignments.

B Access to hospitals

Table 8: Admissions to hospitals by type of admission and urgency, ±12 months from the last month before the first pharmacy opening

	Medical urgent		Surgical urgent		Medical planned		Surgical planned	
Access	n obs.	f	n obs.	f	n obs.	f	n obs.	f
ED	3,569,842	0.938	998,995	0.906	116,521	0.138	228,420	0.106
GP	76,584	0.020	21,749	0.020	121,181	0.144	230,527	0.107
Planned	52,071	0.014	27,303	0.025	570,238	0.676	1,682,234	0.780
Transfer	106,947	0.028	54,688	0.050	35,295	0.042	16,519	0.008
Total	3,805,444	1.000	1,102,735	1.000	843,235	1.000	2,157,700	1.000

Note — Total number of admissions ±12 months from the last month before the first pharmacy opening for the selected sample of Italian provinces by type of admission and urgency. *ED* stands for emergency department, meaning that the patient has been admitted to a hospital after a visit to the ED itself. *GP* stands for general practitioner, indicating that the patient has been sent to a hospital upon medical referral. *Planned* admissions are preplanned by the hospital itself, whilst *Transfers* corresponding to individuals who were already hospitalised in other institutions.

C Additional descriptions and further details on the institutional setting and hospitalization data

The responsibility for the provision of healthcare in Italy is given to local administrations, that is, either one of the nineteen regions or one of the two autonomous provinces, Trento and Bolzano. As a consequence, the national healthcare system is made up of twenty-one local healthcare systems. The flow of information regarding the archive of hospital discharges from regional and autonomous provinces administrations to central offices is strictly regulated by the offices, which also define the common set of variables that must be recorded.

We drop from our analysis admissions that took place after October 30th, 2019, as a nonnegligible fraction of those admitted afterwards could still be in the hospital after December 31st and therefore not discharged before the end of the year. In addition, we drop data for Lazio, as this region shows an irregular trend over time, which could call the validity of these data into question. Our data do not include records corresponding to MDC-14 (pregnancy, childbirth and puerperal interventions), MDC-15 (newborn and other neonates, i.e., perinatal period interventions), MDC-22 (burns), or MDC-25 (human immunodeficiency virus infection - HIV).

C.1 Additional descriptive statistics for expenditures

Table 9: Average monthly spending in euros per 1,000 residents ± 12 months from the implementation for non-selected MDCs

	Medical Discharges			*Surgical discharges*		
	Overall	Planned	Urgent	Overall	Planned	Urgent
MDC-02: Eye	28	5	24	105	76	29
	(18)	(5.6)	(16)	(48)	(41)	(18)
MDC-03: Ear, nose, mouth, and throat	91	24	67	329	292	37
	(37)	(15)	(30)	(123)	(120)	(20)
MDC-07: Hepatobiliary system and pancreas	657	148	509	664	434	229
	(158)	(65)	(132)	(173)	(132)	(88)
MDC-09: Skin, subcutaneous tissue and breast	128	27	101	306	278	28
	(53)	(22)	(48)	(99)	(95)	(24)
MDC-10: Endocrine, nutritional, metabolic	189	35	154	221	210	10
	(81)	(26)	(78)	(85)	(82)	(14)
MDC-11: Kidney and urinary tract	605	109	496	830	583	247
	(192)	(68)	(165)	(218)	(185)	(103)
MDC-12: Reproductive (male)	28	6	22	294	277	17
	(16)	(5.9)	(15)	(117)	(116)	(12)
MDC-13: Reproductive (female)	35	7	29	482	409	73
	(19)	(7.7)	(16)	(147)	(145)	(39)
MDC-16: Blood, immune system	168	26	142	31	19	13
	(57)	(20)	(49)	(21)	(16)	(13)
MDC-17: Poorly differentiated neoplasms	529	300	229	225	180	45
	(170)	(123)	(105)	(102)	(88)	(34)
MDC-18: Infectious diseases	710	39	670	124	24	101
	(301)	(32)	(293)	(88)	(30)	(77)
MDC-19: Mental diseases	271	37	234	6	4	3
	(93)	(30)	(89)	(14)	(12)	(6.1)
MDC-20: Alcohol/drug use	22	6	16	0	0	0
	(17)	(8.2)	(13)	(0)	(0)	(0)
MDC-21: Poisonous drug effects	62	7	55	93	26	68
	(28)	(6.8)	(26)	(46)	(22)	(36)
MDC-23: Other	73	21	51	80	72	9
	(35)	(14)	(30)	(43)	(41)	(12)
MDC-24: Multiple traumatic accidents	31	1	30	111	2	109
	(23)	(3)	(22)	(73)	(8.4)	(72)
n obs.	2,300	2,300	2,300	2,300	2,300	2,300

Source: Italian Ministry of Health. Average spending between twelve months before and after the first pharmacy opening per 1,000 residents in euros for the MDCs we include in the *other* category.

Table 10: Average monthly spending in euros per 1,000 residents, 2010-2019

	Medical Discharges			*Surgical discharges*		
	Overall	Planned	Urgent	Overall	Planned	Urgent
Expenditures	10,055	1,833	8,222	13,171	7,659	5,512
	(2095)	(754)	(1864)	(2949)	(2367)	(974)
Nervous	1,388	179	1,209	752	384	368
	(366)	(117)	(311)	(208)	(153)	(130)
Respiratory	2,265	251	2,013	336	236	100
	(631)	(147)	(629)	(127)	(98)	(60)
Cardiocirculatory	1,689	249	1,440	3,300	1,632	1,668
	(459)	(134)	(394)	(927)	(656)	(453)
Digestive	754	114	640	1,654	805	849
	(212)	(68)	(184)	(407)	(277)	(202)
Musculoskeletal	289	89	200	3,152	1,641	1,511
	(104)	(54)	(76)	(947)	(751)	(348)
Other	3,671	951	2,720	3,977	2,961	1,016
	(797)	(375)	(691)	(920)	(830)	(235)
n obs.	9,024	9,024	9,024	9,024	9,024	9,024

Source: Italian Ministry of Health. Average spending between 2010 and 2019 per 1,000 residents in euros per MDC.

C.2 Descriptive statistics for hospitalisation rate

Table 11: Monthly hospitalisation rate per 1,000 residents one year before and after policy implementation

	Medical Discharges			*Surgical discharges*		
	Overall	Planned	Urgent	Overall	Planned	Urgent
Hospitalisation	3.570	0.648	2.922	2.504	1.657	0.847
	(0.708)	(0.227)	(0.638)	(0.622)	(0.557)	(0.13)
Nervous	0.424	0.061	0.363	0.083	0.052	0.031
	(0.107)	(0.038)	(0.091)	(0.024)	(0.02)	(0.01)
Respiratory	0.656	0.057	0.599	0.042	0.030	0.012
	(0.195)	(0.033)	(0.198)	(0.015)	(0.012)	(0.007)
Cardiocirculatory	0.594	0.097	0.497	0.399	0.189	0.209
	(0.151)	(0.049)	(0.134)	(0.108)	(0.079)	(0.046)
Digestive	0.334	0.043	0.291	0.307	0.169	0.137
	(0.094)	(0.025)	(0.081)	(0.09)	(0.073)	(0.03)
Muscolo-skeletal	0.143	0.034	0.109	0.601	0.333	0.268
	(0.051)	(0.018)	(0.042)	(0.173)	(0.149)	(0.059)
Other	1.418	0.356	1.063	1.072	0.883	0.188
	(0.281)	(0.115)	(0.247)	(0.296)	(0.286)	(0.042)
n obs.	2,300	2,300	2,300	2,300	2,300	2,300

Source: Italian Ministry of Health. Hospitalisation rate between twelve months before and after the first pharmacy openings per 1,000 residents per MDCs.

Table 12: Monthly hospitalisation rate per 1,000 residents one year before and after policy implementation

	Medical Discharges			*Surgical discharges*		
	Overall	Planned	Urgent	Overall	Planned	Urgent
MDC-02: Eye	0.098	0.015	0.084	0.158	0.091	0.067
	(0.073)	(0.02)	(0.068)	(0.086)	(0.055)	(0.054)
MDC-03: Ear, nose, mouth, throat	0.354	0.071	0.283	0.423	0.348	0.075
	(0.156)	(0.051)	(0.132)	(0.152)	(0.138)	(0.046)
MDC-07: Hepatobiliary System And Pancreas	1.936	0.303	1.633	0.902	0.420	0.482
	(0.433)	(0.149)	(0.4)	(0.257)	(0.146)	(0.191)
MDC-09: Skin, Subcutaneous Tissue And Breast	0.441	0.083	0.358	0.432	0.351	0.081
	(0.188)	(0.065)	(0.171)	(0.164)	(0.137)	(0.071)
MDC-10: Endocrine, nutritional, metabolic	0.697	0.121	0.576	0.231	0.204	0.026
	(0.263)	(0.09)	(0.257)	(0.099)	(0.083)	(0.042)
MDC-11: Kidney and urinary tract	1.859	0.273	1.585	1.112	0.692	0.421
	(0.542)	(0.165)	(0.486)	(0.291)	(0.211)	(0.17)
MDC-12: Reproductive (male)	0.095	0.019	0.077	0.426	0.385	0.041
	(0.058)	(0.023)	(0.053)	(0.168)	(0.162)	(0.038)
MDC-13: Reproductive (female)	0.133	0.022	0.111	0.666	0.520	0.146
	(0.069)	(0.027)	(0.061)	(0.21)	(0.189)	(0.085)
MDC-16: Blood, immune system	0.650	0.080	0.570	0.049	0.021	0.028
	(0.233)	(0.067)	(0.217)	(0.044)	(0.023)	(0.036)
MDC-17: Poorly Differentiated Neoplasms	1.147	0.649	0.498	0.272	0.173	0.099
	(0.332)	(0.248)	(0.214)	(0.133)	(0.09)	(0.087)
MDC-18: Infectious diseases	1.747	0.113	1.634	0.178	0.033	0.145
	(0.702)	(0.095)	(0.684)	(0.147)	(0.052)	(0.131)
MDC-19: Mental diseases	1.744	0.231	1.513	0.013	0.004	0.009
	(0.707)	(0.214)	(0.655)	(0.031)	(0.013)	(0.028)
MDC-20: Alcohol/Drug Use	0.097	0.022	0.076	0.000	0.000	0.000
	(0.085)	(0.034)	(0.072)	(0)	(0)	(0)
MDC-21: poisonous drug effects	0.201	0.023	0.178	0.161	0.040	0.121
	(0.103)	(0.03)	(0.096)	(0.099)	(0.048)	(0.084)
MDC-23: Other	0.324	0.111	0.213	0.092	0.075	0.017
	(0.169)	(0.09)	(0.132)	(0.062)	(0.051)	(0.03)
MDC-24: Multiple traumatic accidents	0.058	0.001	0.056	0.109	0.002	0.107
	(0.048)	(0.008)	(0.047)	(0.086)	(0.012)	(0.085)
n obs.	2,300	2,300	2,300	2,300	2,300	2,300

Source: Italian Ministry of Health. Hospitalisation rate between twelve months before and after the first pharmacy opening per 1,000 residents per those MDCs we include in *other* category.

Table 13: Monthly hospitalisation rate per 1,000 residents, 2010-2019

	Medical Discharges			*Surgical discharges*		
	Overall	Planned	Urgent	Overall	Planned	Urgent
Hospitalisation	3.857	0.781	3.076	2.530	1.695	0.835
	(0.828)	(0.313)	(0.682)	(0.645)	(0.581)	(0.133)
Nervous	0.469	0.399	0.069	0.085	0.056	0.030
	(0.125)	(0.043)	(0.102)	(0.025)	(0.022)	(0.01)
Respiratory	0.643	0.573	0.070	0.041	0.029	0.012
	(0.172)	(0.042)	(0.172)	(0.016)	(0.012)	(0.007)
Cardiocirculatory	0.683	0.569	0.114	0.382	0.187	0.195
	(0.193)	(0.061)	(0.165)	(0.107)	(0.078)	(0.049)
Digestive	0.371	0.318	0.054	0.323	0.181	0.141
	(0.11)	(0.032)	(0.092)	(0.097)	(0.08)	(0.031)
Muscolo-skeletal	0.176	0.130	0.046	0.601	0.340	0.261
	(0.074)	(0.027)	(0.057)	(0.182)	(0.156)	(0.057)
Other	1.514	1.087	0.427	1.098	0.902	0.196
	(0.33)	(0.162)	(0.26)	(0.303)	(0.291)	(0.047)
n obs.	9,024	9,024	9,024	9,024	9,024	9,024

Source: Italian Ministry of Health. Hospitalization rate between 2010 and 2019 per 1,000 residents per MDCs.

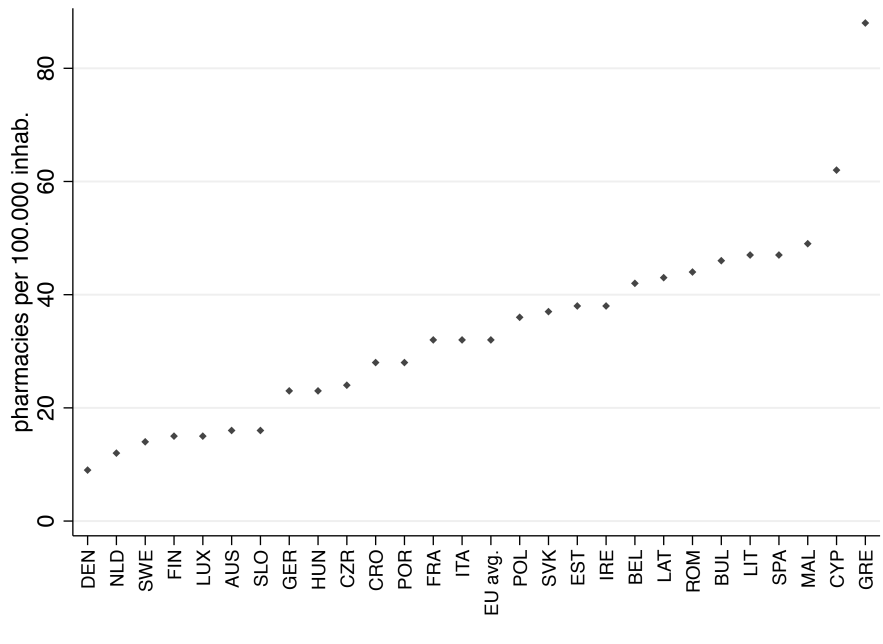

Figure 7: Number of pharmacies in the EU

Note — Source: ABDA statistics, Pharmaceutical Group of the European Union (PGEU), national pharmaceutical associations, European Commission (EC). Data refer to the last available year.

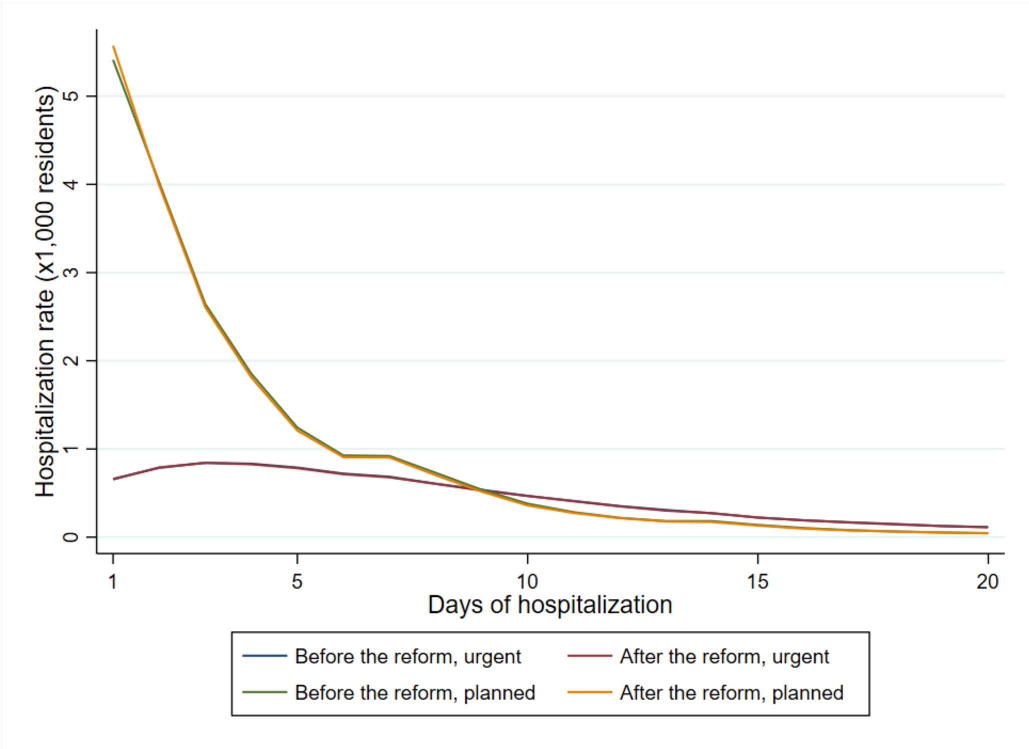

Figure 8: Length of surgical hospitalizations

Note — Our elaboration on the Ministry of Health data. We plot the hospitalization rate for planned and urgent surgical discharges in the 12 months preceding/following the opening of the first pharmacy, conditioning on days of hospitalization.

C.3 Results by type of discharge

Our data, alongside with detailed information on the personal characteristics of patients and the series of procedures performed, allow us to identify the modality of the discharge itself, i.e. whether the patient was sent home (with or without activation of home nursing), was transferred to another hospital or a rehabilitative structure or a hospice or another loral healthcare structure, or died in hospital. We run the main analysis as from eq.1 and we report results for medical admissions only, being the effect of the policy null for surgical ones in baseline specification. We focus separately on medical admissions that ended up with the death of the patient, which are unlikely to be affected by pharmacies, or anything else, as these are the most likely to be treatable in pharmacies. We split the discharges into two groups and we run the RDiT model on the two separated samples and we report results in table 14 below.

Table 14: Heterogeneous effect by discharge type for urgent medical admissions

	Overall	*Nervous*	*Respiratory*	*Cardiocirculatory*	*Digestive*	*Musculoskeletal*	*Other*
Δ *hospitalisation: deceased or discharged patients*							
Discharges	-0.013**	-0.020**	-0.018	0.006	-0.044**	-0.068***	-0.016*
	(0.006)	(0.011)	(0.013)	(0.013)	(0.017)	(0.026)	(0.009)
Deaths	-0.026	-0.020	0.042	-0.060	0.090	0.109	0.018
	(0.019)	(0.053)	(0.031)	(0.039)	(0.072)	(0.084)	(0.031)

Note — $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$. Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of hospitalisation rate (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + \alpha_2 \text{above}_p \cdot \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$) both for discharges thant ended up with patients death or not. We report the main estimates of medical hospitalizations. We assume a quadratic polynomial allowed to differ on either side of the threshold.

We find that the increase in the number of pharmacies reduces medical hospitalizations with a non-death discharge by 1.3%, and we do not find any effect on medical hospitalisation that resolved in patients death. Hence, if the effect is driven by milder hospitalisation rather than hospitatisation with more severe conditions, which are more likely to be associated to patients death.

D Other policies

During the period considered in the empirical analysis, some interventions aimed at rationalizing health expenditures involved the various components of the national health system. In 2005, Law 311/2004 introduced repayment plans (*piani di rientro*), which are agreements among the Ministry of Health, the Ministry of Economy and Finance, and individual regions. Between February 2007 and December 2010, ten regions signed repayment plans. These plans contained both measures aimed at guaranteeing the provision of essential levels of assistance (LEA) and measures designed to guarantee the correct financial management of the health system. Furthermore, other measures mandated a progressive reduction in the number of hospital beds, and new spending ceilings and a different system for the purchase and management of goods and services were introduced.[24] In Fig. 9, we plot the yearly average hospital bed distribution across Italian provinces from 2010 to 2019. In addition to the policies just described, other interventions took place and affected health expenditures over the time period considered.

Here, we discuss whether competing measures may threaten our results. The empirical strategy used in the study is a regression-in-time-discontinuity design. This is a quasi-experimental technique designed to measure the effect of a treatment by comparing the dependent variable immediately before and immediately after the moment of treatment.[25] In words, by comparing the observations lying near the threshold and assuming that confounding factors do not change discontinuously between the moment immediately preceding the treatment and that immediately following it, it is possible to isolate the desired treatment effect. Our study, using monthly data, implements this design using the time of the opening of a group of pharmacies in a given province as a treatment dummy. In our case, the assumption that identifies the effect is that the confounding factors do not change discontinuously exactly in conjunction with the treatment. To the best of our knowledge, this latter possibility has not been verified. To fully address any possible concern related to the existence of competing factors that may affect the results, we propose two robustness checks that are able to validate our empirical strategy. We use data from the Italian Ministry of Health, and in Table 15, we include the log of hospital beds per inhabitant as a control at the province and year levels. Furthermore, in Table 16, we include a dummy for regions that are subject to a repayment plan. Overall, the results are very similar to the main results in Table 4: the coefficients do not change, and the inclusion of these additional controls does not alter the estimated treatment effect. This result both shows that neither the repayment plans nor the reduction in hospital beds are confounding factors in the analysis and supports the validity of the empirical design.

[24] e.g., the law decreed on September 13th, 2012 and the law decreed on April 2nd, 2015, n. 70.

[25] A flexible and interrupted polynomial isolates the causal effects of the intervention. See specification Eq. (1).

Table 15: Expenditure - control for hospital beds

	Medical	Medical Planned	Medical Urgent	Surgical	Surgical planned	Surgical Urgent
Overall						
	-0.013*	-0.007	-0.014*	-0.011	-0.016	-0.003
	(0.007)	(0.014)	(0.007)	(0.008)	(0.012)	(0.011)
Avg. exp. per 1,000 inhab.	10,449	1,614	8,835	13,647	7,680	5,967
Nervous system						
	-0.031***	0.014	-0.040***	-0.004	-0.001	0.000
	(0.013)	(0.062)	(0.015)	(0.051)	(0.101)	(0.300)
Avg. exp. per 1,000 inhab.	1,452	177	1,275	779	366	413
Respiratory system						
	-0.008	0.031	-0.012	0.009	0.106	-0.059
	(0.013)	(0.031)	(0.015)	(0.014)	(0.024)	(0.017)
Avg. exp. per 1,000 inhab.	2,491	215	2,276	339	238	100
Cardio-circulatory system						
	0.011	0.018	0.009	-0.014	-0.044*	0.011
	(0.013)	(0.031)	(0.015)	(0.014)	(0.024)	(0.017)
Avg. exp. per 1,000 inhab.	1,594	226	1,368	3,501	1,658	1,843
Digestive system						
	-0.035*	-0.089	-0.029	-0.003	-0.005	-0.008
	(0.018)	(0.070)	(0.018)	(0.020)	(0.027)	(0.028)
Avg. exp. per 1,000 inhab.	780	100	681	1,659	776	884
Muscolo-skeletal system						
	-0.058*	-0.025	-0.064*	-0.009	-0.017	-0.006
	(0.030)	(0.068)	(0.035)	(0.010)	(0.020)	(0.013)
Avg. exp. per 1,000 inhab.	259	76	183	3,357	1,695	1,661
Others						
	-0.021**	-0.015	-0.018**	-0.014	-0.015	-0.005
	(0.009)	(0.020)	(0.009)	(0.013)	(0.016)	(0.025)
Avg. exp. per 1,000 inhab.	3,872	820	3,053	4,012	2,947	1,065

Note — $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$. Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of government expenditure per 1,000 inhabitants (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$). We assume a quadratic polynomial allowed to differ on either side of the threshold. Overall, the opening of new pharmacies reduced spending on medical hospitalizations by 1.3 percentage points.

E Robustness and functional form assumption

Algorithms for optimal RDD bandwidth choice (e.g., Calonico et al., 2014) are not meant for RDiT, and this is why the bandwidth size used in the regression is arbitrarily set to twelve months. We check whether the results are robust to different bandwidth sizes. Fig. 10 reports the coefficients of government expenditures for specification Eq. (1) with smaller

Table 16: Expenditure - control for repayment plans

	Medical	Medical Planned	Medical Urgent	Surgical	Surgical planned	Surgical Urgent
Overall						
	-0.013**	-0.003	-0.015**	-0.011	-0.015	-0.005
	(0.006)	(0.014)	(0.007)	(0.008)	(0.012)	(0.011)
Avg. exp. per 1,000 inhab.	10,449	1,614	8,835	13,647	7,680	5,967
Nervous system						
	-0.033***	0.015	-0.042***	-0.004	0.002	-0.004
	(0.012)	(0.032)	(0.013)	(0.027)	(0.039)	(0.061)
Avg. exp. per 1,000 inhab.	1,452	177	1,275	779	366	413
Respiratory system						
	-0.011	0.042	-0.015	0.004	0.109	-0.109
	(0.014)	(0.063)	(0.015)	(0.051)	(0.102)	(0.293)
Avg. exp. per 1,000 inhab.	2,491	215	2,276	339	238	100
Cardio-circulatory system						
	0.011	0.020	0.008	-0.015	-0.043*	0.009
	(0.013)	(0.032)	(0.015)	(0.014)	(0.024)	(0.017)
Avg. exp. per 1,000 inhab.	1,594	226	1,368	3,501	1,658	1,843
Digestive system						
	-0.035*	-0.080	-0.029	-0.004	-0.004	-0.011
	(0.018)	(0.070)	(0.018)	(0.020)	(0.027)	(0.028)
Avg. exp. per 1,000 inhab.	780	100	681	1,659	776	884
Muscolo-skeletal system						
	-0.057*	-0.016	-0.065*	-0.009	-0.015	-0.008
	(0.029)	(0.069)	(0.034)	(0.010)	(0.020)	(0.013)
Avg. exp. per 1,000 inhab.	259	76	183	3,357	1,695	1,661
Others						
	-0.021**	-0.012	-0.018**	-0.014	-0.014	-0.008
	(0.009)	(0.020)	(0.009)	(0.014)	(0.016)	(0.026)
Avg. exp. per 1,000 inhab.	3,872	820	3,053	4,012	2,947	1,065

Note — $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$. Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of government expenditure per 1,000 inhabitants (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$). We assume a quadratic polynomial allowed to differ on either side of the threshold. Overall, the opening of new pharmacies reduced spending on medical hospitalizations by 1.3 percentage points.

and larger bandwidth sizes expressed in months. The main coefficient is stable and remains significant, and overall, the results are robust to different bandwidth specifications.

Then, we discuss the robustness to the time trend functional form assumption. In Table 17, we report the results of specification Eq. (1) when we assume a linear time trend before and after the reform. Since we use a bandwidth of twelve months before and after the reform, the time span seems large enough to make a linear model less appealing. Nevertheless, the

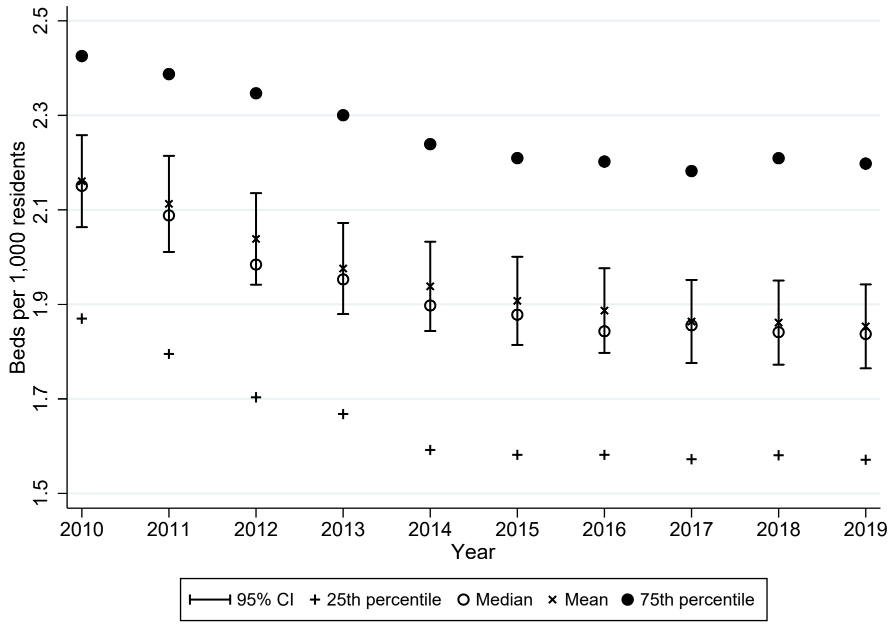

Figure 9: Hospital beds in Italian provinces, 2010-2019

Note: The yearly average of hospital bed distribution in Italian provinces from 2010 to 2019.— Source: Our calculation using Ministry of Health open data on hospital beds by discipline and structure, https://www.dati.salute.gov.it/dati/dettaglioDataset.jsp?menu=dati&idPag=96

results are qualitatively confirmed.

Moreover, an issue specific to RDiT specifications is the presence of an autoregressive component in the dependent variable. This issue is discussed in detail in Hausman and Rapson (2018), who propose including a lag of the dependent variable to address the presence of the autoregressive process. Note that the autoregression in the outcome variable is different from the autoregression of residuals, which is addressed via clustering standard errors at the provincial level. Table 17 reports the main results when the lagged dependent variable is included as a regressor and shows that the main results do not change.

F Effect on the number of hospitalizations per speciality

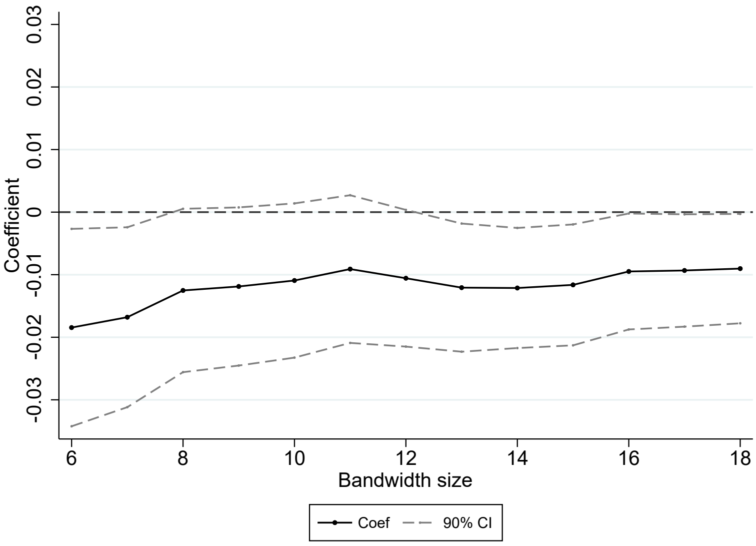

Figure 10: Robustness check changing bandwidth size

Note — Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of government expenditure for medical hospitalizations per 1,000 inhabitants (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$) for different bandwidth sizes. We assume a quadratic polynomial allowed to differ on either side of the threshold. The dashed lines mark the 90% confidence interval. Overall, the results are robust to different bandwidth size specifications.

Table 17: Expenditures with different functional forms

	Quadratic	Linear	Linear with lag	Quadratic with lag
Overall				
	-0.013**	-0.005	-0.003	-0.013**
	(0.006)	(0.005)	(0.004)	(0.006)
Nervous system				
	-0.032***	-0.020*	-0.020***	-0.033***
	(0.011)	(0.007)	(0.006)	(0.011)
Respiratory system				
	-0.009	-0.000	0.003	-0.004
	(0.013)	(0.010)	(0.008)	(0.012)
Cardiocirculatory system				
	0.011	0.018**	0.016**	0.010
	(0.013)	(0.009)	(0.007)	(0.012)
Digestive system				
	-0.036*	-0.028**	-0.027**	-0.037**
	(0.018)	(0.012)	(0.011)	(0.017)
Musculoskeletal system				
	-0.058*	0.004	0.005	-0.053*
	(0.030)	(0.020)	(0.019)	(0.029)
Others				
	-0.022**	-0.013*	-0.011*	-0.021**
	(0.009)	(0.007)	(0.006)	(0.008)

Note — $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$. Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of government expenditure per 1,000 inhabitants (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m + \epsilon_{pm}$). We assume a quadratic polynomial allowed to differ on either side of the threshold. Overall, the opening of new pharmacies reduced spending on medical hospitalizations by 1.3 percentage points.

Table 18: Number of hospitalizations

	Medical	Medical Planned	Medical Urgent	Surgical	Surgical planned	Surgical Urgent
Overall						
	-0.011*	-0.008	-0.011	-0.002	-0.002	-0.002
	(0.006)	(0.013)	(0.007)	(0.008)	(0.013)	(0.009)
Nervous system						
	-0.017*	0.046	-0.029**	-0.008	-0.031	0.004
	(0.010)	(0.030)	(0.012)	(0.026)	(0.035)	(0.051)
Respiratory system						
	-0.020	-0.035	-0.024*	0.029	0.026	0.024
	(0.013)	(0.036)	(0.014)	(0.039)	(0.047)	(0.068)
Cardiocirculatory system						
	0.003	0.012	0.004	-0.010	-0.030	0.003
	(0.012)	(0.029)	(0.014)	(0.013)	(0.022)	(0.016)
Digestive system						
	-0.038**	-0.066	-0.036**	0.018	0.034	-0.005
	(0.017)	(0.045)	(0.017)	(0.016)	(0.025)	(0.022)
Musculoskeletal system						
	-0.069***	-0.045	-0.071**	0.001	-0.004	0.002
	(0.025)	(0.045)	(0.029)	(0.010)	(0.019)	(0.014)
Others						
	-0.013	-0.013	-0.010	-0.005	-0.004	-0.011
	(0.009)	(0.017)	(0.009)	(0.012)	(0.016)	(0.019)

Note — $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$. Standard errors clustered at the regional level are in parentheses. The results of specification Eq. (1) use the log of hospitalizations per 1,000 inhabitants (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_{\text{m}} + f(\text{month}_{\text{m}}) + \phi_p + \eta_m \epsilon_{pm}$). We assume a quadratic polynomial allowed to differ on either side of the threshold. Overall, the opening of new pharmacies reduced the number of medical hospitalizations per 1,000 inhabitants by 1.1 percentage points.

G Consumption of medicines at pharmacies and hospitals

Here, we describe the aggregate public expenditures for pharmaceuticals and investigate possible variations following the reform. According to Italian law, there are three broad groups of pharmaceuticals that follow different payment schemes. The first group is composed of pharmaceuticals for individuals who have chronic diseases and are entirely reimbursed by the National Health System (NHS). These are distributed by pharmacies upon medical prescription. The second group of pharmaceuticals consists of those that are used in hospitals and, in the case of public hospitals, are purchased with public funds. The third class of pharmaceuticals differentiates between those that require a medical prescription and those that do not. The former can be totally or partially reimbursed by NHS, i.e., a level of copayment is required, while the latter are to be paid for by the consumer. From the repository of regional healthcare system balances, we derive the annual expenditures for pharmaceuticals that are distributed in hospitals (those that are in the second group) and annual expenditures for reimbursements given to pharmacies for pharmaceuticals belonging to the first and third

The analysis is meant to proxy for related consumption and exploit monthly data from the Italian Ministry of Health. We run the following model: $y_{rm} = \alpha_0 + \alpha_1 \text{post}_m + t + \phi_r + \epsilon_{rm}$, where t is a linear time trend, and the coefficient reported in the table is α_1. y_{rm} is the log of expenditures per 1,000 inhabitants on a dummy denoting the initial month of the reform (the time dimension is normalized at the month of the first opening of a new pharmacy following the reform in each region), and we include regional and month fixed effects and different types of time trends. Although we acknowledge that there are very few regions, Table 19 shows interesting descriptive correlations. The overall public expenditures for medicines does not change with the reform, but there is an interesting compositional effect: the consumption of medicines at hospitals decreases, while that at pharmacies increases.

Table 19: Expenditure for medicines or drugs (net of time trend)

	at pharmacies		at hospitals		overall	
post_m	0.030*	0.047***	-0.042**	-0.029*	-0.012	0.018
	(0.015)	(0.012)	(0.016)	(0.015)	(0.021)	(0.020)
Reg linear trend	No	Yes	No	Yes	No	Yes
Time linear trend	Yes	-	Yes	-	Yes	-

Note — Source: The Italian Ministry of Health (https://www.salute.gov.it/). The results of specification Eq. (1) use public expenditures for medicines or drugs (model: $y_{pm} = \alpha_0 + \alpha_1 \text{post}_\text{m} + f(\text{month}_\text{m}) + \phi_p + \eta_m \epsilon_{pm}$; we assume a linear time trend, and the coefficient reported in the table is α_1). The time (before/after dummy and the time trend) is normalized at the month of the initial opening of a new pharmacy following the reform in each region. The second and fourth columns add a region-specific linear trend.

Table 20: Hospitalizations for drug intoxication

	(1) Hosp.	(2) Exp.	(3) Days
Drug toxic effects	0.019	0.008	0.081
	(0.071)	(0.119)	(0.139)
Mean dep. var.	0.0	16.0	0.1
n	1973	1973	1973

Note — Source: The Italian Ministry of Health (https://www.salute.gov.it/). The results for specification Eq. (1) use the log of hospitalizations, expenditures and days of hospitalization for drug intoxication (model: $y_{pm} = \alpha_0 + \alpha_1 \mathrm{post_m} + f(\mathrm{month_m}) + \phi_p + \eta_m \epsilon_{pm}$).

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