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PIANO NAZIONALE DI RIPRESA E RESILIENZA

UNIVERSITÀ DEGLI STUDI DI GENOVA

Telehealth for chronic diseases: Addressing the needs of vulnerable populations in Liguria

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HEALTH NEEDS AND RESOURCES: ALLOCATION and MEASUREMENT ISSUES
Department of Economics, Society, Politics
University of Urbino Carlo Bo
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1506 UNIVERSITÀ DEGLI STUDI DI URBINO CARLO BO

Introduction

- **Future sustainability of healthcare systems:** progressively aging population along with growing budget constraints → Management of chronic conditions

- **Role of telemedicine**: improves accessibility via digital means → during/after the COVID pandemic

- The **share of adults who have received services from doctors via telemedicine** since the start of the pandemic has increased in most countries (Leporatti and Montefiori, 2024).

- Before the pandemic, **Denmark** had the highest share of remote consultations via phone or video (45 %), whereas most countries had percentages lower than 10 %. By mid-2020, almost one in three adults had utilized remote consultation, and by early 2021, this ratio accounted for nearly one in two (OECD, 2021).

- Given the increasing budget pressures on healthcare systems in Western countries, can or will telemedicine help? How?

Objective

Analyze the effects of telemedicine on chronic patients in Liguria, focusing on:

- **Resource utilization**: impact on NHS resource consumption and costs
- **Substitute or complement**: Does telemedicine replace or supplement traditional visits?
- **Health outcomes:** adherence to drug therapy (mortality?)

Relevance of the case study:

- **Geographical conformation**: mountainous inland with extensive coastal region (Istat, 2021)
- **Demographic setting**: highest over-65s population in Europe, predicting future trends (Eurostat, 2020)
- **COVID-19 pandemic**

Research Questions

RQ1: Does TeleHealth serve as a substitute for or complement to traditional healthcare services?

RQ2: Can higher adherence reduce the utilization of healthcare services?

RQ3: How does the consumption of healthcare resources relate to adherence and TeleHealth?

Related Literature

Telemedicine:

- *Benefits*: increased life expectancy (Bernstein et al., 2010); improved health (Singh et al., 2019); reduced costs (Patel et al., 2023)
- *Risks*: lower-quality treatments (Dahlgren et al., 2024); more follow-ups (Zeltzer et al., 2023); no cost savings (Snoswell et al., 2020)

Telemonitoring:

- *Benefits*: reduced hospitalizations (Agboola et al., 2015); better doctor-patient relationship (Miranda et al., 2023); improved quality of life (Voeller et al., 2022)
- *Risks*: temporary benefits (Agboola et al., 2015); false positives/misinterpretation (Hanley et al., 2018); no cost savings (Vasquez-Cevallos et al., 2018)

Related Literature

- ***Zeltzer, D., Einav, L., Rashba, J., & Balicer, R. D. (2023a). The Impact of Increased Access to Telemedicine. Journal of the European Economic Association.***: increased telemedicine access is associated with a modest, 3.5% increase in the utilization of primary care. While access to telemedicine is associated with a slight increase in the number of follow-up visits, such visits are predominantly with the same physicians who provided the initial visit. Visits involve fewer prescriptions and more follow-ups, but no evidence of missed diagnoses or adverse outcomes

- ***Dahlgren, C., Spånberg, E., Sveréus, S., Dackehag, M., Wändell, P., & Rehnberg, C. (2024). Short- and intermediate-term impact of DTC telemedicine consultations on subsequent healthcare consumption. European Journal of Health Economics:*** DTC telemedicine users increased their healthcare consumption more than controls. The effect seemed to be mostly short term (within a month), but was also present at the intermediate term (2–6 months after the initial consultation).

- **Conflicting evidence**: The literature does not agree on whether telemedicine services effectively substitute traditional in-person visits.

Related Literature

The European Journal of Health Economics (2024) 25:157–176
https://doi.org/10.1007/s10198-023-01572-z

ORIGINAL PAPER

Check for updates

Short- and intermediate-term impact of DTC telemedicine consultations on subsequent healthcare consumption

Cecilia Dahlgren[1,2] · Emma Spånberg[1,3] · Sofia Sveréus[1,2] · Margareta Dackehag[4] · Per Wändell[5] · Clas Rehnberg[1]

Table 1 Potential mechanisms for the impact of DTC telemedicine on subsequent healthcare consumption

Mechanism	Expected impact	Time perspective
Technology: DTC telemedicine is not sufficient for solving the problem, physical examination is necessary	More subsequent face-to-face consultations for DTC telemedicine users	Short term
Provider incentives: DTC telemedicine providers are reimbursed based on a payment per contact principle, whereas the dominating reimbursement model for primary healthcare centres is capitation. DTC telemedicine providers, therefore, have stronger financial incentives to offer additional consultations	More subsequent DTC telemedicine consultations for DTC telemedicine users	Short term
Case mix: DTC telemedicine users can be expected to be healthier than face-to-face users because of the lower thresholds for accessing healthcare	Fewer subsequent consultations (DTC telemedicine and face-to-face) for DTC telemedicine users	Short term
Patient behaviour: DTC telemedicine users adapt their healthcare-seeking behaviour and increase their use of DTC telemedicine	More subsequent DTC telemedicine consultations for DTC telemedicine users	Intermediate term

Related Literature

Adherence & COVID-19:

- Reduced adherence, particularly among patients with chronic conditions (Di Novi et al., 2022; Bitar & Alismail, 2021)

Adherence & telemedicine:

- Addressing unmet healthcare needs, particularly in the post-pandemic period (Huerne & Eisenberg, 2024)
- Improved communication, minimizing therapy discontinuity (Basit et al., 2020; Miller, 2002; Gadkari & McHorney, 2012).

Institutional context

- In November 2020, Regione Liguria initiated a large-scale expansion of telemedicine adoption.
- In 2021, the regional council approved a project called "**Tigullio Luogo di Salute**" (TLS) within ASL4.
- TLS was launched as a **pilot project** aimed at systematizing, standardizing, and integrating telemedicine tools into patient care services, maximizing the opportunities provided by new technologies and prioritizing a "patient-centered" approach.
- Two primary areas of intervention:
  - ✓ Televisits for diabetic patients
  - ✓ Telemonitoring for cardiovascular patients

Dataset Overview

- **Source**: healthcare administrative data from ASL 4
- **Time period**: 2019-2022
- **Data streams**:
  - ED visits
  - Drug records
  - Demographic data
  - Exemption records
  - Specialist services
  - Discharge data

- **Limitations**: no access to death/transfer data
- **Privacy Compliance**: data pseudonymized; aggregated age categories (0-45; 46-65; 65+)
- **Panel dataset**: annually and semester panels

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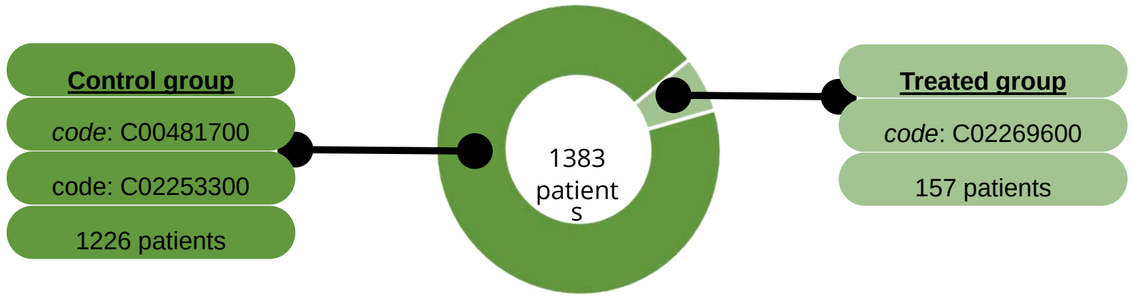
Inclusion criteria

Patients with severe cardiac conditions requiring pacemakers, defibrillators, loop recorders, or CCM

- **Identification**: specialist service codes during hospitalization or follow-up
- **Exclusion**: non-residents to prevent data inconsistencies due to high tourist influx



Patients with Type 1 and Type 2 diabetes

Three criteria:

- primary recovery codes for hospital admissions and emergency department admissions (i.e. 285, 294, 295, 250)
- the use of specific drugs coded A10A*, N03AX16 or N03AX12,
- exemptions 013.250

6486 patients

- 6205 subjected to several/no traditional visits
- 281 had access to telemedicine as a second visit or remote control of devices.

Treated and control groups: a comparison

	Control	Treated
Age class		
< 45	3.76%	11.75%
45-64	14.25%	21.20%
65+	81.99%	67.05%
Male	50.52%	51.58
CCI	0.89	0.94
Coastal Municipality	70.55%	68.19%

The treated patients are on average younger but have a higher CCI.

Outcome variables

Proxies for **resource consumption** and associated costs

- Number of ED visits
- number of hospitalisations
- Number of traditional specialistic visits
- Cost of hospitalisations
- Cost of specialist visits

Adherence to drug therapy

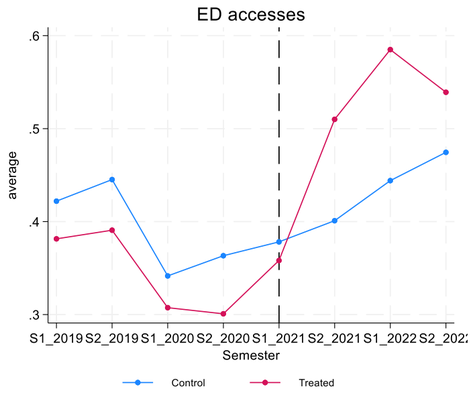
Medical Possession Rate

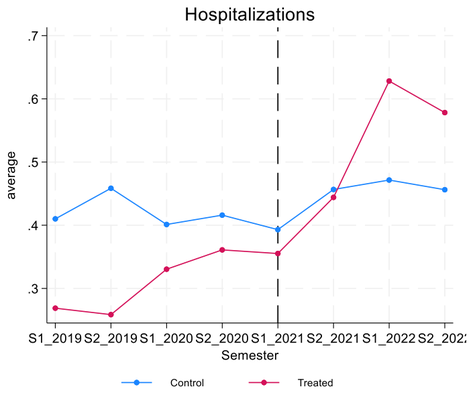
$$MPR = \frac{number\ of\ days'\ supply\ in\ the\ period}{last\ fill\ date - first\ fill\ date}\ x\ 100$$

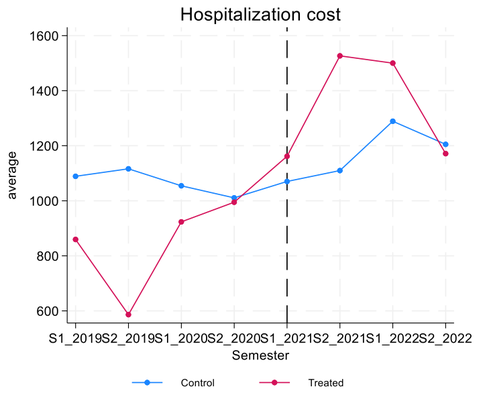
- Diabetes: the 2 most consumed drugs in category A: Alimentary tract and metabolism (ATC A02BC02, A10BA02)
- Cardiovascular diseases in category C : the 2 most consumed drugs in A: Alimentary tract and metabolism (C03CA01 and C07AB07)

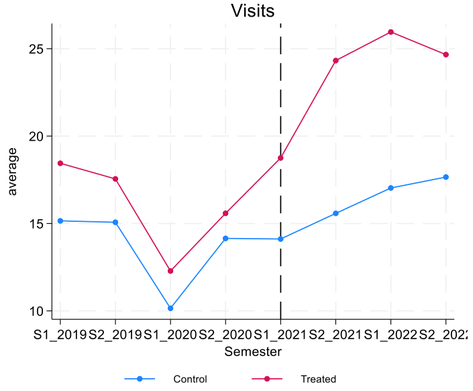
Trend in outcome variables

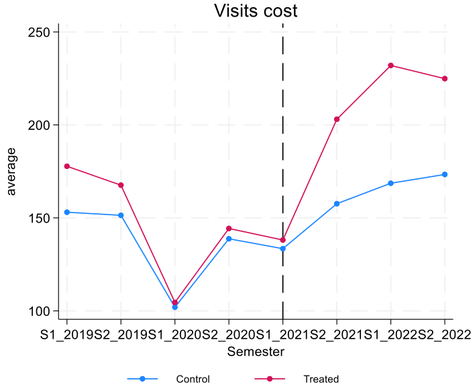
Proxies for **resource consumption** and associated costs





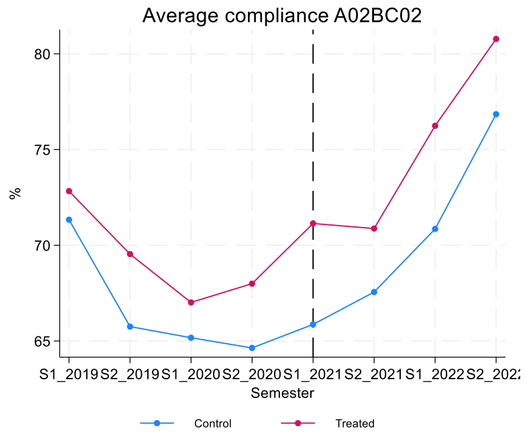


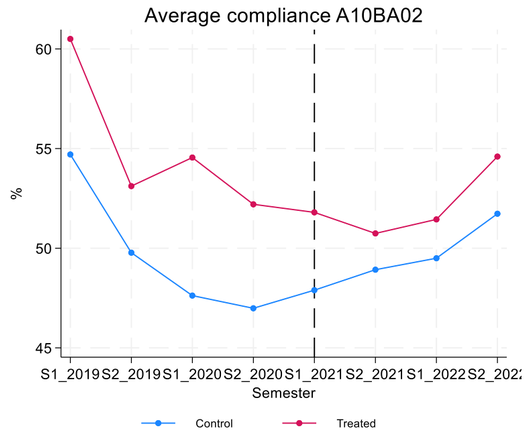


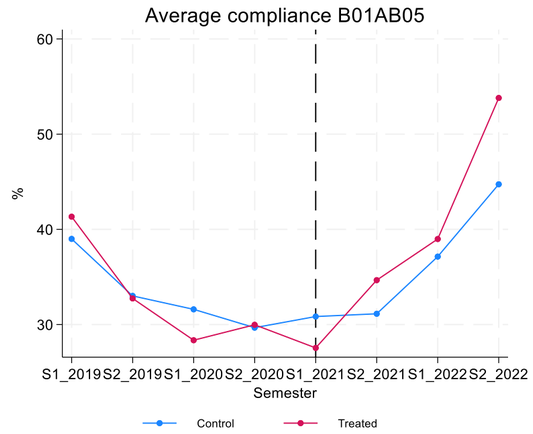


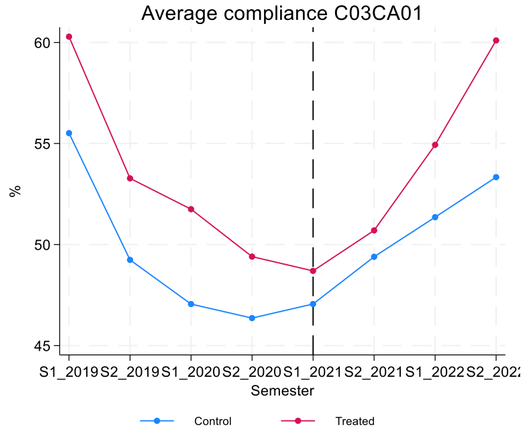
Trend in outcome variables

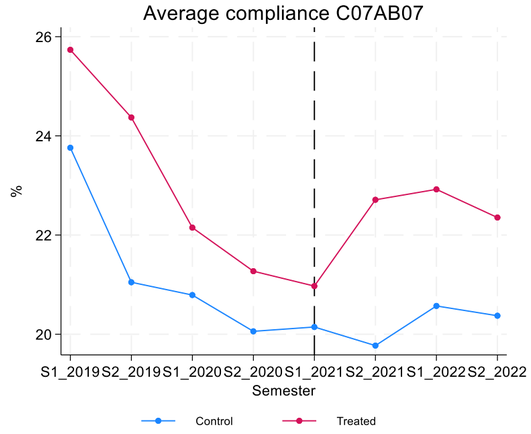
Adherence to drug therapy











RQ1: Does TeleHealth serve as a substitute for or complement to traditional healthcare services?

- **Empirical strategy**:

- Difference in Difference

$$Y_{it} = \beta_0 + \beta_1 Telemedicine_i + \delta_{DiD} Telemedicine_i * Post_t + \tau_t + \beta_1 X_{it} + \varepsilon_{it}$$

Treatment

- **Interaction between Treatment dummy and Post treatment dummy**
- **Interaction between Treatment and time periods (Dynamic)**

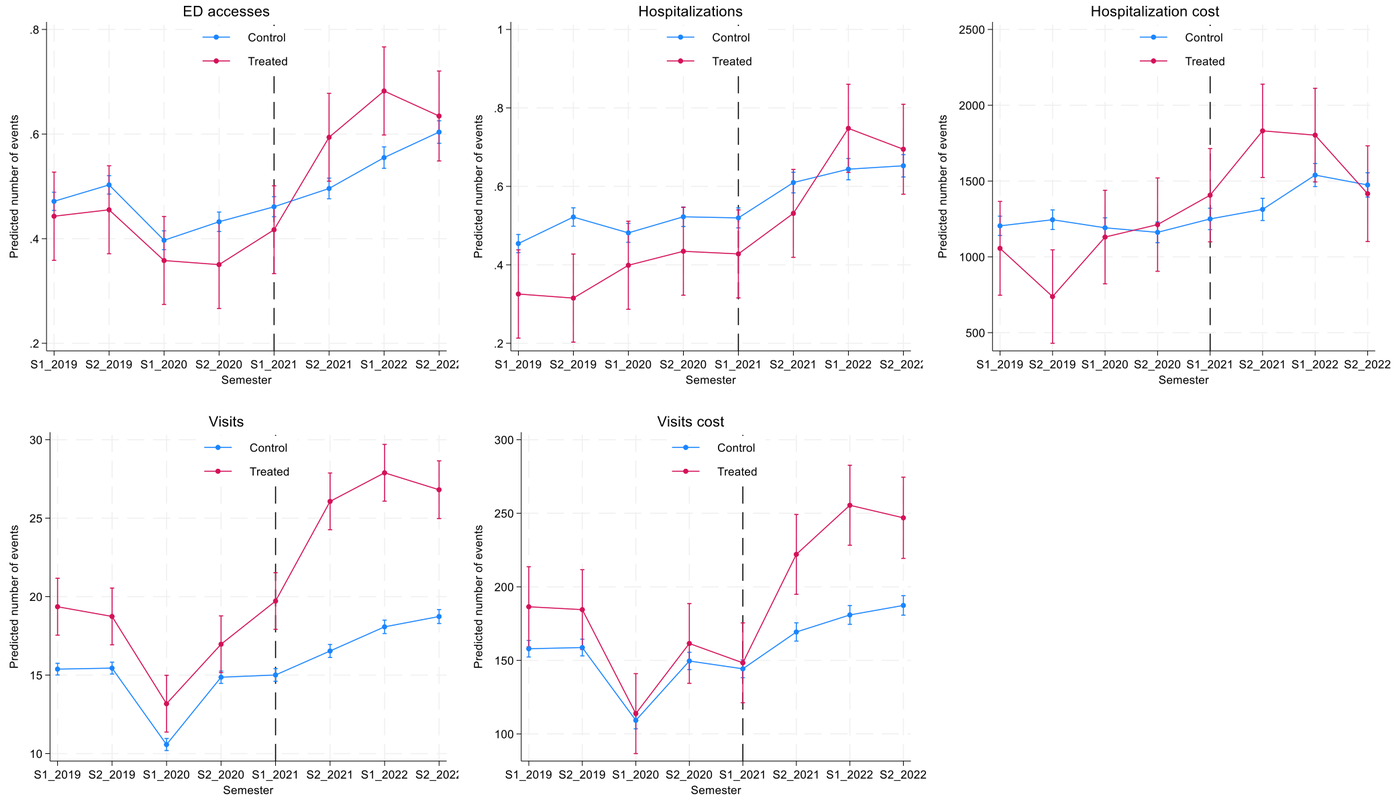
Controls

- **Demographics**: gender, age group
- **Health status**: exemptions, comorbidities

RQ1: Does TeleHealth serve as a substitute for or complement to traditional healthcare services?

	ED accesses		Hospitalizations		Hospitalizations cost		Number of visits		Visits cost	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Telemedicine ∗ Post	0.134***		0.141***		349.060**		5.828***		47.345***	
	(0.036)		(0.046)		(138.962)		(0.670)		(9.807)	
Telemedicine	-0.048	-0.028	-0.120***	-0.129*	-102.048	-148.394	3.336***	3.977***	14.977	28.534*
	(0.030)	(0.052)	(0.043)	(0.070)	(91.610)	(192.059)	(0.779)	(1.126)	(12.009)	(16.907)
Telemedicine x 2019_S2		-0.019		-0.078		-358.424		-0.685		-2.763
		(0.068)		(0.087)		(266.456)		(1.283)		(18.782)
Telemedicine x 2020_S1		-0.010		0.046		87.026		-1.376		-23.964
		(0.068)		(0.087)		(266.591)		(1.284)		(18.793)
Telemedicine x 2020_S2		-0.053		0.041		199.226		-1.874		-16.631
		(0.068)		(0.087)		(266.585)		(1.284)		(18.796)
Telemedicine x 2021_S1		-0.015		0.037		305.102		0.735		-24.464
		(0.068)		(0.088)		(266.832)		(1.285)		(18.815)
Telemedicine x 2021_S2		0.126*		0.050		666.598**		5.556***		24.206
		(0.068)		(0.088)		(267.081)		(1.287)		(18.833)
Telemedicine x 2022_S1		0.156**		0.233***		411.733		5.841***		46.028**
		(0.069)		(0.088)		(267.825)		(1.290)		(18.890)
Telemedicine x 2022_S2		0.059		0.171*		90.583		4.103***		31.022
		(0.070)		(0.089)		(271.223)		(1.308)		(19.147)
Semester fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of Obs	49420	49420	49420	49420	49420	49420	49420	49420	49420	49420

RQ1: Does TeleHealth serve as a substitute for or complement to traditional healthcare services?



Resource consumption positively affected by:

- Sex (Male)
- Charlson Comorbidity Index
- Age

Heterogeneity – Age class and CCI

	Age Class			CCI		Type of patient		Type of user	
	< 45	45-64	65 +	Lower	Higher	Diabetic patients	Cardiovascular patients	Occasional Users (1-2)	Intensive tele-health users (2+)
ED accesses	-0.060	0.136	0.180***	0.090**	0.316***	0.144***	0.120**	0.132***	0.196***
Hospitalization	0.185	0.137	0.145***	0.152***	0.051	0.135**	0.065	0.137***	0.075
Hospitalization cost	143.312	-393.738	593.412***	301.415**	464.343	240.640	205.715	368.914***	458.041**
Number of Visits	7.532***	3.657**	6.298***	4.027***	14.371***	6.705***	5.507***	5.293***	6.794***
Visits cost	48.348**	19.858	56.138***	27.638***	140.419***	51.005***	77.164***	43.405***	45.384***
Number of observation	2037	7408	39975	0.090**	7986	36659	19379	49373	48844

Stronger effects for:

- Older
- Patients with high CCI
- Diabetic

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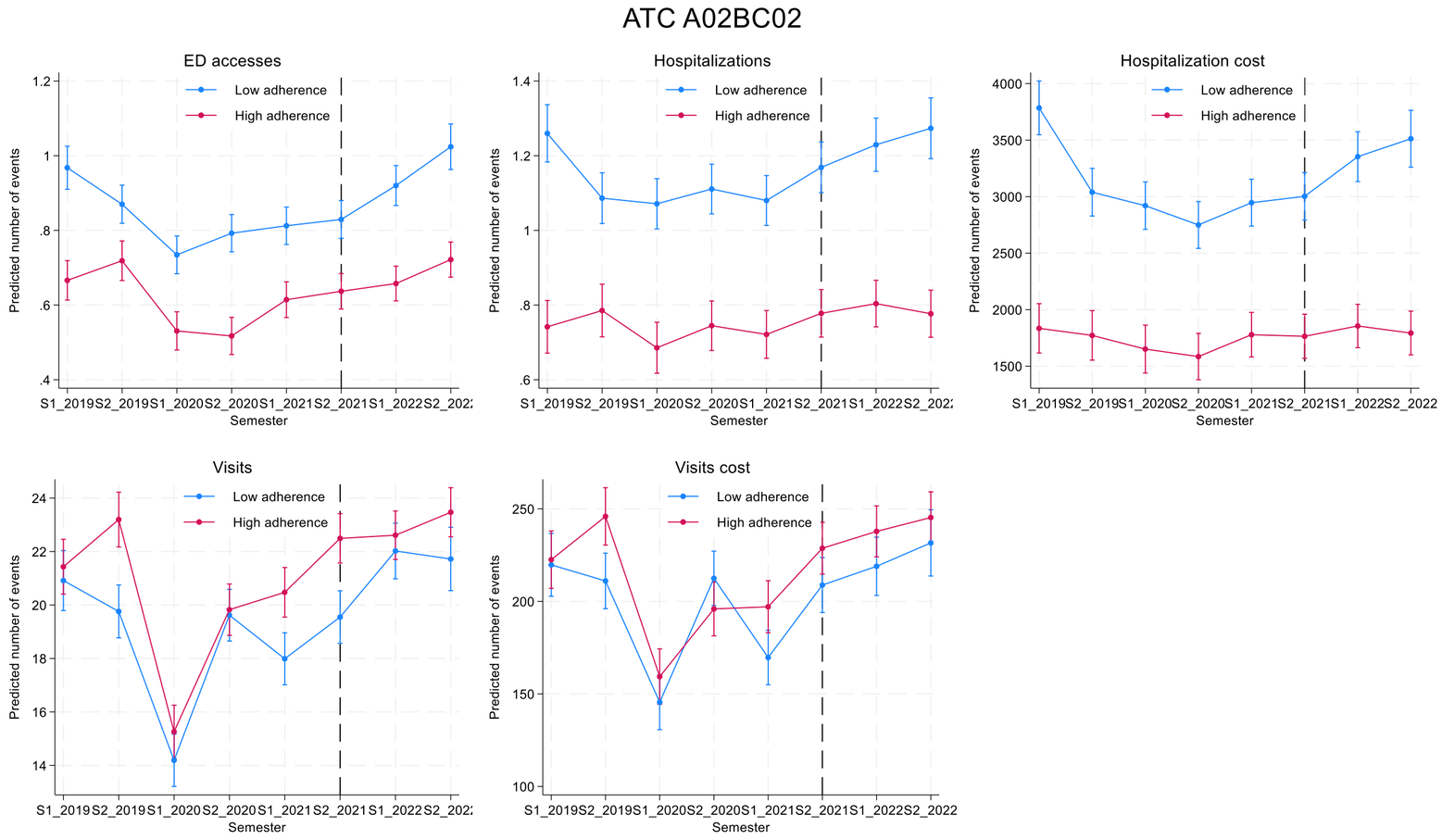
RQ2: Can higher adherence reduce the utilization of healthcare services?

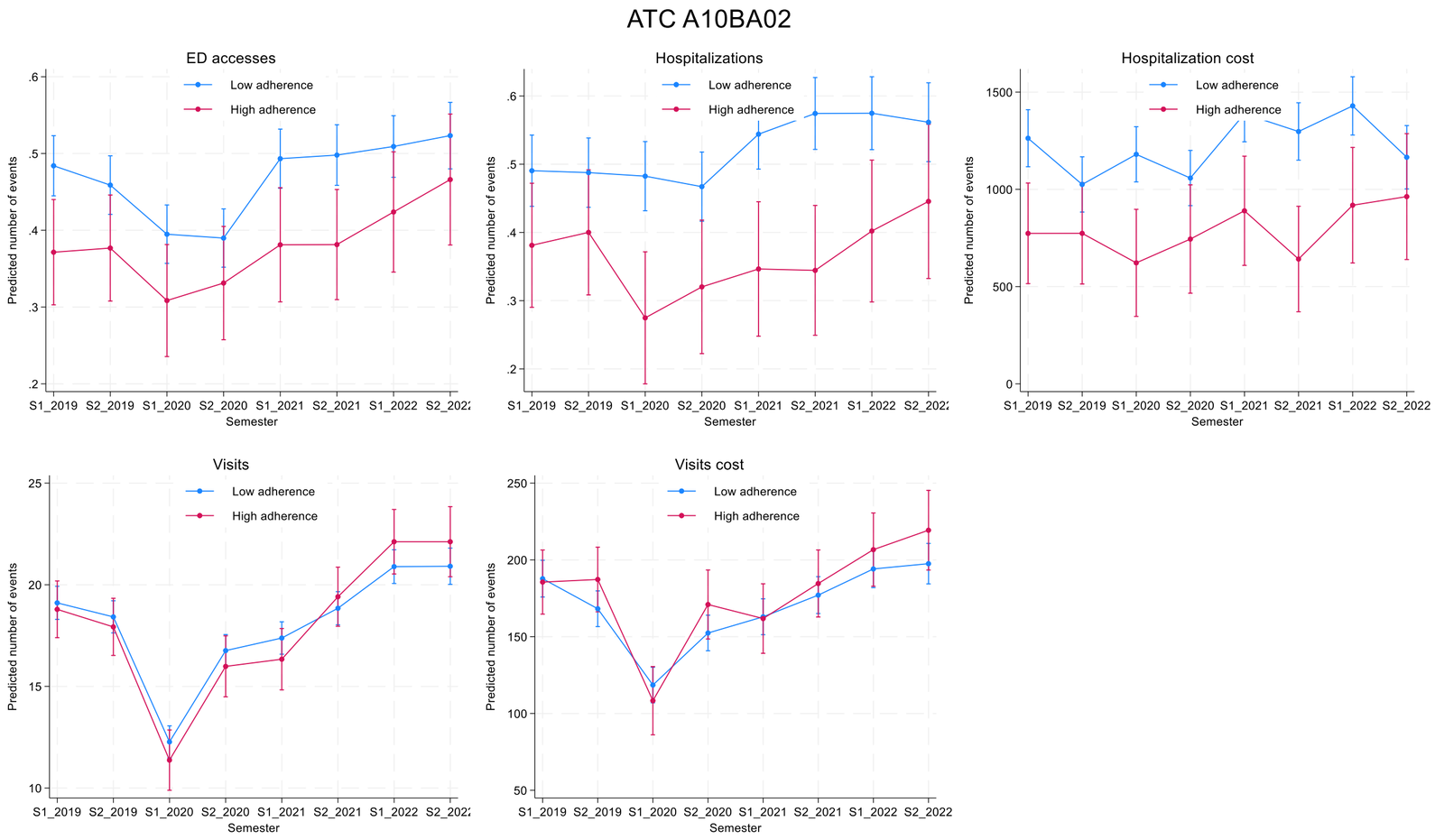
Higher adherence leads to reduced use of emergency departments (EDs) and hospitalizations among diabetic patients.



RQ2: Can higher adherence reduce the utilization of healthcare services?

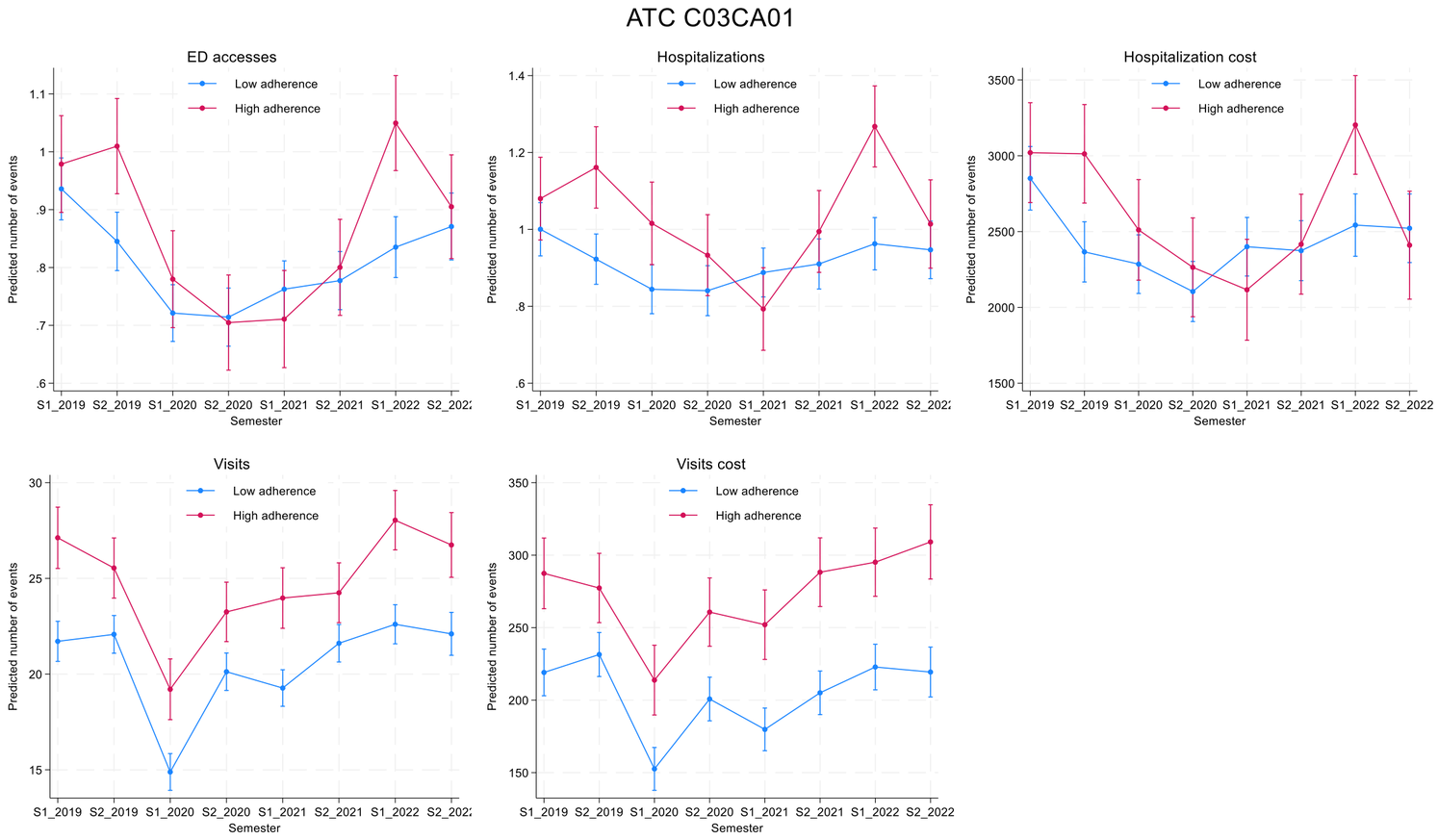
	ED accesses	Hospitalizations	Hospitalization cost	Number of visits	Visits cost
Male	0.029	0.055	334.116***	1.232**	22.292***
	(0.022)	(0.034)	(77.702)	(0.523)	(8.428)
Age 45-64	-0.210*	0.019	200.131	0.885	37.830
	(0.122)	(0.178)	(448.218)	(2.708)	(42.977)
Age 65+	-0.220*	-0.031	-20.074	0.602	10.815
	(0.119)	(0.172)	(436.890)	(2.624)	(41.601)
CCI	0.103***	0.064***	188.608***	1.449***	18.988***
	(0.006)	(0.010)	(21.996)	(0.151)	(2.435)
Exemptions	-0.004	-0.003	-20.306	0.626***	10.744***
	(0.006)	(0.010)	(21.966)	(0.149)	(2.395)
Barrier Index	-0.006	-0.002	9.721	-0.002	-1.764
	(0.005)	(0.007)	(16.810)	(0.113)	(1.815)
2019_S2#High adherence	-0.151***	-0.301***	-1267.002***	3.437***	34.872***
	(0.044)	(0.057)	(182.446)	(0.826)	(12.336)
2020_S1#High adherence	-0.204***	-0.386***	-1269.137***	1.070	13.850
	(0.043)	(0.056)	(178.323)	(0.804)	(11.993)
2020_S2#High adherence	-0.275***	-0.366***	-1164.783***	0.204	-16.550
	(0.042)	(0.055)	(174.337)	(0.787)	(11.734)
2021_S1#High adherence	-0.198***	-0.359***	-1168.057***	2.486***	27.432**
	(0.041)	(0.054)	(171.254)	(0.776)	(11.587)
2021_S2#High adherence	-0.192***	-0.391***	-1238.628***	2.944***	19.901*
	(0.041)	(0.054)	(171.711)	(0.778)	(11.614)
2022_S1#High adherence	-0.262***	-0.425***	-1498.102***	0.591	18.870
	(0.042)	(0.056)	(175.387)	(0.802)	(11.990)
2022_S2#High adherence	-0.302***	-0.497***	-1719.164***	1.748**	13.704
	(0.046)	(0.061)	(191.177)	(0.878)	(13.152)
Treated	-0.071	-0.248***	-157.556	5.743***	28.658
	(0.050)	(0.077)	(171.489)	(1.200)	(19.441)
Constant	1.046***	1.197***	3441.119***	17.442***	162.727***
	(0.124)	(0.179)	(460.929)	(2.719)	(43.003)
Time fixd effects	YES	YES	YES	YES	YES
Number of Obs	17071	17071	17071	17071	17071

RQ2: Can higher adherence reduce the utilization of healthcare services?



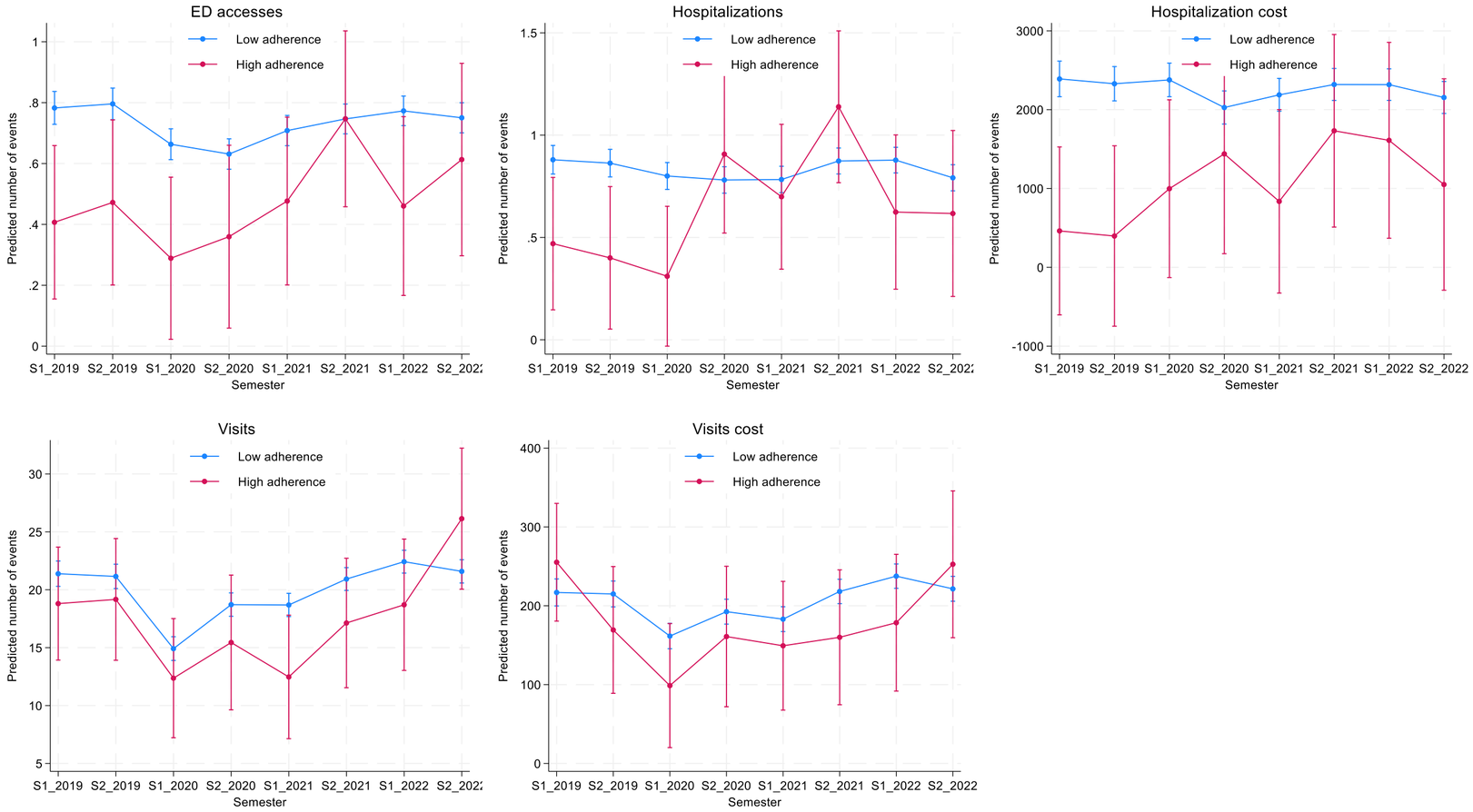
RQ2: Can higher adherence reduce the utilization of healthcare services?

The evidence is weaker for cardiovascular patients. → long run effects?



RQ2: Can higher adherence reduce the utilization of healthcare services?

ATC C07AB07



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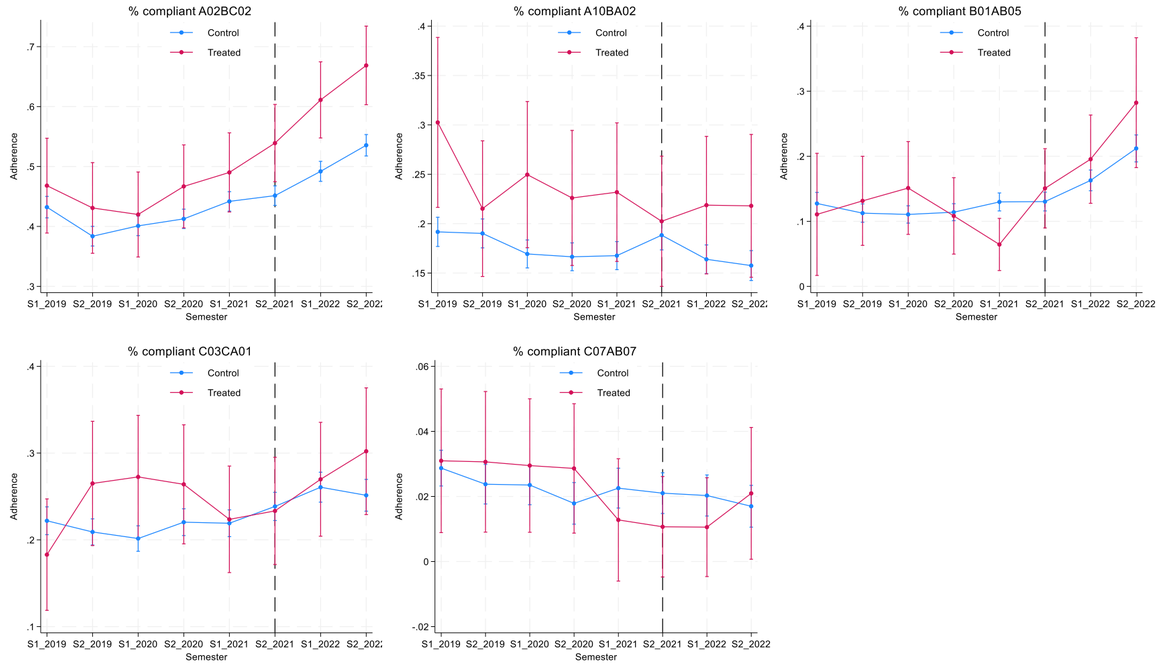
RQ3: How does the consumption of healthcare resources relate to adherence and TeleHealth?

	A02BC02_D	A10BA02_D	B01AB05_D	C03CA01_D	C07AB07_D
	Model 1	Model 1	Model 1	Model 1	Model 1
$Telemedicine * Post$	0.520**	-0.289	0.814*	-0.150	-1.175
	(0.206)	(0.310)	(0.475)	(0.252)	(1.142)
$Telemedicine$	0.328	0.849**	-0.219	0.309	0.501
	(0.231)	(0.379)	(0.477)	(0.296)	(1.107)
Semester fixed effects	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Number of Obs	17071	11437	8351	12117	8701



RQ3: How does the consumption of healthcare resources relate to adherence and TeleHealth?

- **Outcome Variables**: ED visits, hospitalizations → endogenous variable Adherence
- **Empirical strategy**: We use a simultaneous equation model for binary variables. We constructed a joint model of adherence and medical care utilization that we estimated by using a **recursive bivariate probit** model which also takes into account the individuals unobserved heterogeneity which may characterize this relationship.

EQ1: Hospitalizations/ED accesses in the semester (Yes/No)

EQ2: Adherent to drug therapy

$$y*_{1i} = \delta_1 y_{2i} + \alpha_1' z_{1i} + \varepsilon_{1i}$$

$$y*_{2i} = \alpha_2' z_{2i} + \varepsilon_{2i}$$

For reduced form: Instrumental variables for Drug adherence: Number of pharmacy in the municipality

RQ3: How does the consumption of healthcare resources relate to adherence and TeleHealth?

Probability of being hospitalized		
	High adherence	Low adherence
Treated	17%	26%
Control	14%	18%

		A02BC02_D	A10BA02_D	B01AB05_D	C03CA01_D	C07AB07_D
Hospitalizations	High Adherence	-0.257***	-0.186***	-0.195**	-0.047	0.108
		(0.046)	(0.059)	(0.076)	(0.059)	(0.163)
	Telemedicine*Post	0.203*	0.189*	0.354***	0.230***	0.206*
		(0.114)	(0.098)	(0.125)	(0.081)	(0.107)
Adherence	Telemedicine*Post	0.267***	0.042	0.294*	0.070	0.057
		(0.072)	(0.123)	(0.168)	(0.083)	(0.217)
	High Adhernce_Lag	1.526***	1.883***	2.206***	1.606***	3.033***
		(0.031)	(0.052)	(0.066)	(0.045)	(0.163)
	Pharmacy per 1000 ab	0.045*	0.051*	0.048*	0.005	0.065
		(0.025)	(0.028)	(0.027)	(0.028)	(0.068)
	Time fixed effects	YES	YES	YES	YES	YES
	Controls	YES	YES	YES	YES	YES
	athrho	-0.004	0.006	0.231***	0.137***	-0.123
		(0.029)	(0.038)	(0.050)	(0.037)	(0.096)
	Number of Obs	12581	9017	4579	8617	6455

RQ3: How does the consumption of healthcare resources relate to adherence and TeleHealth?

Probability of accessing ED		
	High adherence	Low adherence
Treated	24%	26%
Control	19%	20%

		A02BC02_D	A10BA02_D	B01AB05_D	C03CA01_D	C07AB07_D
PS accesses	High Adherence	-0.080*	-0.131**	-0.263***	-0.068	-0.130
		(0.046)	(0.055)	(0.072)	(0.059)	(0.142)
	Telemedicine*Post	0.068	0.133	0.310**	0.197**	0.129
		(0.075)	(0.101)	(0.132)	(0.083)	(0.116)
Adherence	Telemedicine*Post	0.267***	0.043	0.296*	0.071	0.052
		(0.074)	(0.123)	(0.169)	(0.083)	(0.220)
	High Adhernce_Lag	1.526***	1.883***	2.208***	1.607***	3.038***
		(0.031)	(0.052)	(0.066)	(0.045)	(0.162)
	Pharmacy per 1000 ab	0.046*	0.052*	0.043*	0.005	0.065
		(0.025)	(0.028)	(0.027)	(0.028)	(0.068)
	Time fixed effects	YES	YES	YES	YES	YES
	Controls	YES	YES	YES	YES	YES
	athrho	-0.094***	0.024	0.192***	0.137***	-0.098
		(0.029)	(0.036)	(0.048)	(0.037)	(0.088)
	Number of Obs	12581	9017	4579	8617	6455

Heterogeneity

Hospitalizations	Base Model		Age < 65		Low CCI		High CCI		Costal municipality	
	High adherence	Low adherence	High adherence	Low adherence	High adherence	Low adherence	High adherence	Low adherence	High adherence	Low adherence
Treated	17%	26%	13%	18%	11%	20%	17%	22%	18%	24%
Control	14%	18%	13%	18%	10%	16%	23%	33%	14%	19%

ED accesses	Base Model		Age < 65		Low CCI		High CCI		Costal municipality	
	High adherence	Low adherence	High adherence	Low adherence	High adherence	Low adherence	High adherence	Low adherence	High adherence	Low adherence
Treated	24%	26%	16%	15%	12%	22%	36%	30%	26%	24%
Control	19%	20%	16%	18%	14%	14%	24%	26%	19%	21%

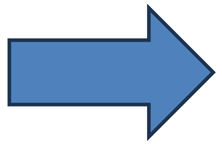
Robustness and further work

Robustness

- Modify temporal dimension (year-month)
- Apply matching techniques
- Heterogeneous difference in differences for month periods
- Modify outcome definitions

Limitations

- **Short implementation period**: only one-two years of data
- **Small groups**
- **Data gaps**: missing death and transfer information
- **Broad age groups**: may impact analysis precision



Extend the analysis to ASL3 Genovese

Finanziato dall'Unione europea NextGenerationEU
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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
UNIVERSITÀ DEGLI STUDI DI GENOVA

Policy Implications

Results

- **Increased NHS resource use**: higher service utilization
- **Complementary role**: telemedicine supports, rather than replaces, traditional care
- **Possible indirect effect** via drug adherence

Policy implications

- **Integration with traditional care**: integrate telemedicine with traditional care
- **Targeted programs**: focus on the elderly and those with comorbidities
- **Geographical focus**: invest in telecommunication for regions like Liguria
- **Ongoing evaluation**: support long-term studies to measure impact

APHEC

Study and Research Centre

APHEC Forth Workshop

Healthcare Sustainability and Challenges: Current Trends and Future Perspectives

Genoa, 12-13 September 2025

The issue of future sustainability of healthcare systems is of great importance in all European countries, characterized by a progressively aging population (and a consequent increase in healthcare needs) along with growing budget constraints. The recent pandemic highlighted significant systemic vulnerabilities while also promoting the exploration of alternative healthcare delivery models, including digital healthcare. The acceleration of digitalization in public administration in general (and in healthcare in particular) is a crucial aspect of the Next Generation EU, and we can expect that in the coming years, European countries will increasingly adopt policies in this direction.However, this process has also brought new challenges, such as changes in the doctor-patient relationship and the potential overload of online health information. Additionally, this process is potentially widening the gap between younger and older generations in the use of online healthcare services, with older adults facing technology adoption difficulties. Furthermore, socio-economic disparities may widen, with individuals in lower socio-economic brackets encountering barriers to accessing and effectively using digital healthcare services. These challenges highlight the importance of ensuring fair access and usability of e-health solutions for all societal segments.

The aim of this workshop is to provide a platform for international academic experts to present and discuss their research on various aspects of healthcare sustainability and challenges, including:

- Healthcare financing and policy innovations;
- Impact of e-health, telehealth and telemedicine on access and health outcomes;
- Sustainable healthcare practices and their impact on physical and mental health;
- Healthcare inequalities: socio-economic determinants, disparities in healthcare access and outcomes;
- Healthcare workforce and education;
- New digital technologies in healthcare and human well-being;
- New organizational and collaborative governance models to support digital Innovations.

- Submission deadline: **30 June 2025**

Accepted papers are eligible for a special issue of *Economics and Human Biology*

Guest Editor: Cinzia Di Novi – University of Pavia, Italy

Thanks for the attention!