Appendix

A Device advertisement, acquisition, activation, and use

This section provides additional contextual details on the device.

Advertisement The device was advertised on multiple media channels since 2019. Appendix Figure A12 shows examples of online and print advertisements for the device. Below is an English translation of the print ad text. The title reads: "Clalit Presents: Exams and Consultations Without Leaving the House." The subtitle reads, "Winter? Crowded Emergency Rooms? Clalit has upgraded its home consulting services: longer hours of service with online consults and a revolutionary device for exams at home" The text reads:

> "Clalit offers a perfect solution for medical issues after hours and during weekends. Instead of rushing to a remote emergency room full of people and germs or leaving the house sick during cold winter weather, one can use Clait Online: a service unique to Clalit. This service, provided at no fee, allows members to consult experienced specialists in family, pediatric, and dermatology through a video chat from their smartphone or personal computer. The specialists receive all medical records of the patient and record the visit summary in the patient's medical records in case medical follow-up by a primary care physician or further care is needed. Thus, care and information continuity are maintained, which is important for eliminating errors. When physicians decide that an emergency room visit or a physician follow-up is needed, they equip the patient with a digital referral. Physicians can also electronically prescribe medications. In light of the growing demand, service availability was extended and now starts at 16:00. The service has recently been expanded to include a groundbreaking device named Tyto. The device, developed in Israel, allows for the examination of the throat, ears, pulse, lungs, and more and transmits the information to an online physician through a dedicated app. Thus, the physician can provide a precise and reliable diagnosis. The device fits all ages and is especially convenient for parents of young children who can receive a diagnosis

> and treatment at home without the need to take the child to the clinic, reducing the risk of exposing them to other diseases. Further, the child is being examined by the parent, not by a stranger. The cost of the device is NIS 450, in up to 6 payments with no interest. The purchase can be done online through Clalit's website."

Similar messaging was also used in billboards, radio, web, and television advertisements.

Acquisition The main channel for acquiring the device is online, through the web portal and mobile app of the HMO. Members who click a banner are taken to a landing page from which they can purchase the device at a discount using their member ID. Members can also purchase the device by calling Clalit customer service by phone. In either case, the device is shipped to the patient's home or to a nearby locker within 8 days. The device is also available for purchase in select pharmacies that are operated by Clalit, usually in the vicinity of its clinics (Clalit operates 500 pharmacies, about a third of Israel's total).

Activation The device requires an initial activation that involves installing a dedicated app and connecting the device to a mobile phone with either an Android or iOS operating system via Bluetooth. Device use requires a broadband connection with a minimum speed of 2 Mbps. In 2021, about 90% of Israeli households had such connection available (a notable exception, which accounts for most of the remaining population share are ultra-Orthodox Jews, most of whom do not use the internet and do not have smartphones for religious reasons). Any household member can use the device. Each member has to sign in with their own member ID.

Device use To initiate a visit, patients use the mobile app to pair with the device. They then log in using the member ID of the patient. They are then presented with two options: initiate a visit or pre-record exams. When pre-recording exams, the patients are presented with a few questions to determine which exams should be performed. They then record the exams with guidance from the app and save them. When selecting to initiate a visit, patients are presented with their place in the queue of the online clinic. Once they join a video call with the physician, the physician has access to pre-recorded exams. In addition, the device shifts to remote-activation mode, and

the physician can operate it remotely while guiding the patient to perform additional exams.

B Sample and variable definitions

B.1 Construction of auxiliary samples

Comparison sample of non-adopters To construct the non-adopter sample in Appendix Table A1, we took a random sample of 28,213 Clalit members with at least one primary-care visit in 2020 who had not conducted any device-assisted visit during the study period.

Sample used for descriptive analysis To construct the sample of subsequent index visits used in the descriptive analysis in Section 3.1, we take our main sample of device-assisted index visits and matched video visits and, for each of them, find the first primary care visit that occurred at least thirty days after the index date and with no other physician visits, hospital visits, or lab tests conducted in the thirty days preceding the visit. This yields 27,394 subsequent visits for the sample of 28,213 adopters and 379,592 subsequent visits for the sample of 394,974 non-adopters.

B.2 Variable definitions

Primary care visits Our first set of outcome variables in the event-study and difference-in-differences analyses are weekly measures of the number of primary-care visits conducted in each medium (in-person, phone, video, video + device) and total. To construct these measures, we take all primary-care visits conducted in all of these forms within 26 weeks before and 51 weeks after the index date and count the number of each type of visit, each week, by each member. For example, week 0 is calculated as days 0-6 from the index date, and week -1 is days -7 to -1 from the index date.

Utilization and total cost. To construct our utilization and cost outcomes, we use Clalit's claims data. We observe payments for all services detailed in encounter-level claims data (including inpatient admissions, emergency department visits, treatments and diagnostic services provided in outpatient clinics, both within and outside hospitals, and prescription drug purchases). The spending measures represent actual

payments made by Clalit, not list charges. Even hospitals owned by Clalit are separate financial entities, as they serve both Clalit and non-Clalit patients, so hospital charges in all cases reflect actual payments, not transfer prices. The only exception is office-based consults provided by physicians in Clalit-owned clinics, for which there is no actual charge, as physicians are salaried. For these visits, we (and Clalit) impute per-visit charges based on customary charges by non-employed providers. During the period of our study, these charges were the same for in-person and remote visits. Our total cost measure is computed by adding up, for each patient, the costs of all healthcare activities during the relevant period. Our utilization outcome is the count of distinct days with a billed event during the relevant period.

We also observe cost and use separately for each of the following service categories: prescription drug purchases, primary care physician visits (remote and in-person), lab and imaging procedures, urgent care center visits, emergency department (ER) visits, inpatient admissions, and all other covered services, which includes outpatient visits among many other things. The only utilization outcome not calculated directly from the billing data is antibiotics, which is taken from Clalit's drug-dispensing data. Antibiotics are identified using ATC codes in the data. In particular, the ATC code J01 identifies antibiotics in the dispensing data.

The aforementioned utilization and cost measures are aggregated at a weekly level, similar to the primary care outcomes. The aggregate utilization measure is the number of distinct days with a billed event of any type. The cost measures are calculated as the sum of all costs listed in the given week. Note that costs for multi-day procedures, such as overnight inpatient admissions, are listed on the first day of the procedure and are counted only in the week of the first day. To avoid a disproportional influence of outliers, we winsorize all costs at the 99th percentile.

Visit and follow-up outcomes. For each primary care visit, we observe the diagnosis codes entered by the physician in the visit summary, drugs that the physician prescribed to the patient on the date of the visit (regardless of whether the patient ever filled the prescription), and referrals made on the date of the visit to each of the following providers: physician specialists and surgeons; imaging, including X-ray, ultrasound, computed tomography (CT) scans, electrocardiogram (ECG), mammograms, electromyography (EMG), and magnetic resonance imaging (MRI) and lab tests such as blood and urine tests; and the emergency department (ER).

Variables for heterogeneity analyses For heterogeneity analyses, we split our sample between adults and children, visits during regular and non-regular hours, and by the interaction of gender, age group, SES, and any chronic condition. In several descriptive tables, we include other relevant variables: an indicator for being a parent (defined as having covered child dependents), PCP visits in the prior year, total healthcare cost in the prior year, the number of chronic conditions, and the Adjusted Clinical Groups (ACG) concurrent weight. This section describes these variables in detail.

The patient's gender and date of birth are observed in the Clalit data. ACG concurrent weight is a risk score that is calculated quarterly using a commercial classifier.[14] Chronic condition counts are based on indicators for 123 chronic conditions obtained from a database maintained by Clalit. The ten most common conditions are hyperlipidemia, smoking (as documented in EMR; smoking is a health behavior that is predictive of future healthcare utilization and spending and is thus treated for this purpose as a chronic condition), hypertension, obesity, arthropathy, diabetes, malignancy, ischemic heart disease, arrhythmia, and asthma. The visit location is observed at the level of the subdistrict, an administrative division of Israel into 70 geographic areas, each with a similar number of covered members. SES is calculated based on the Israel Central Bureau of Statistics' socioeconomic classification of the patient's municipality of residence. These classifications are based on national income tax records. We consider members above and below the median SES.

In event-study and difference-in-differences regressions, we include fixed effects for the number of weeks from the index visit and calendar weeks. The number of weeks from the index visit is defined as described above, with days -7 to -1 counted as week -1, days 0 to 6 as week 1, and so on. Calendar week gives a unique value to each week in each year. As an example, 2020w1 refers to January 1 through January 7, and so on.

To split our analysis into adults and children, we take those 17 and younger as children and 18 and over as adults at the index visit. In the analysis of heterogeneous effects, gender, and SES are defined as above; the age groups are adult and child, as described; and any chronic condition takes a value of 1 if there is at least one listed

[14] ACG is a risk-scoring system that is used by both commercial insurers and non-commercial healthcare organizations worldwide (as well as by Clalit) to describe or predict a population's past or future healthcare utilization and costs. It represents the expected cost relative to the population average, normalized to one. See the Johns Hopkins ACG System Version 11.0 Technical Reference Guide (2014) for more information.

condition from the 123 described earlier and 0 otherwise.

For each Clalit member, we observe their father and mother's ID number, so we identify a member of our sample as a parent if we see an associated child in our data. For calculating the number of PCP visits in the prior year, we count all primary care visits of any medium 365 days prior to the index date, excluding the index date itself. For calculating the total cost in the prior year, we sum the cost of all observations in the billing data in the 365 days leading up to the index date.

Classification of admissions We decompose inpatient admissions to "avoidable" and "unavoidable" based on the ICD9 main diagnoses coded of each admission. We use a classification sourced from Magan et al. (2008), which lists ICD9 codes which are considered avoidable in adult admissions, and Zucco et al. (2019), which are considered avoidable in pediatric admissions. We classify any admission with a diagnosis code considered avoidable by either of the above lists as "avoidable" and all other admissions as "unavoidable".

Outcomes for descriptive analysis For each primary care visit, we observe the diagnosis codes entered by the physician in the visit summary, drugs that the physician prescribed to the patient on the date of the visit (regardless of whether the patient ever filled the prescription), and referrals made on the date of the visit by the physician to each of the following providers: labs, imaging, including X-ray, ultrasound, computed tomography (CT) scans, electrocardiogram (ECG), mammogram, electromyography (EMG), and magnetic resonance imaging (MRI) and emergency department (ED). We group all other referral targets, the most common of which are physical therapists and dietitians, as well as referrals to specialists and surgeons under the label Physician or Other Referral. For the prescription and referral outcomes, we generate an indicator for each type with a value of 1 if at least one such prescription or referral was given and 0 otherwise. The outcome Antibiotic Prescription is given a value of 1 if a prescription for a drug with ATC code J01 was written by the same physician to the same patient on the date of the visit. We also observe all diagnoses given in primary care visits, coded using the ICD9 classification system. We then manually grouped the ICD9 codes into diagnosis categories, specifically: respiratory, ear, infectious, eye, genitourinary, administrative, and other.

Exclusion of lockdown periods in robustness analysis For robustness, we conducted our main difference-in-differences exercise excluding all weekly observations that had at least one day that overlapped with one of Israel's three periods of COVID-19 lockdowns: March 25 to May 4, 2020; September 18 to October 17, 2020; and December 27, 2020, to February 7, 2021.

Appendix Figure A1: The Remote Examination Device

A picture of the device and adapters for performing different examinations. Source: `https://www.tytocare.com/`. Accessed April 2023.

Appendix Figure A2: Device Adoption and Utilization Over Time

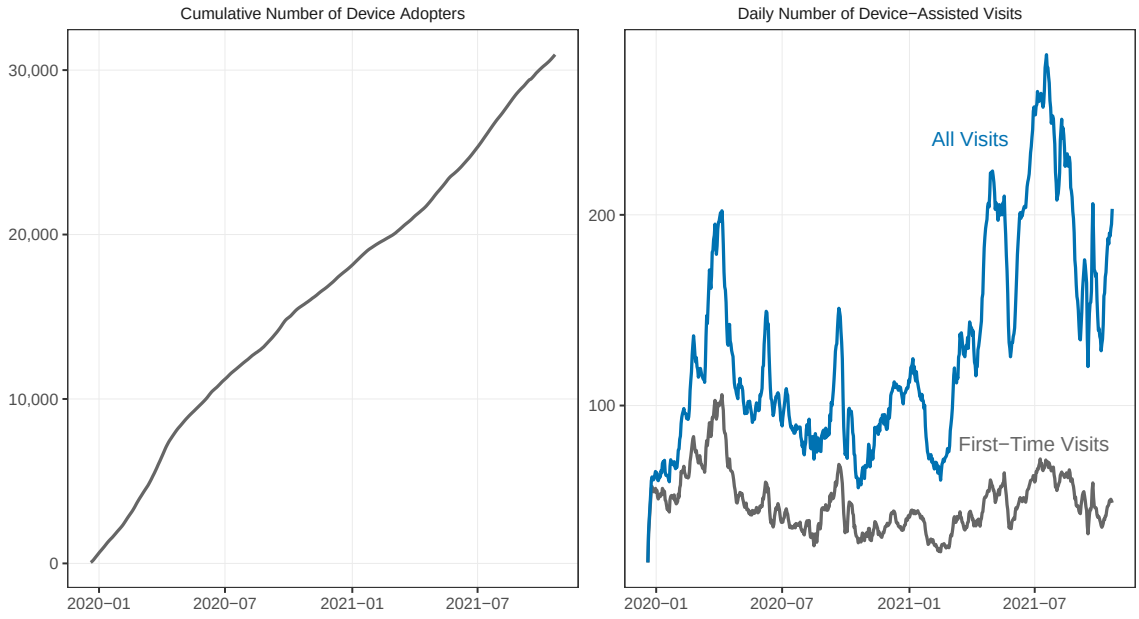
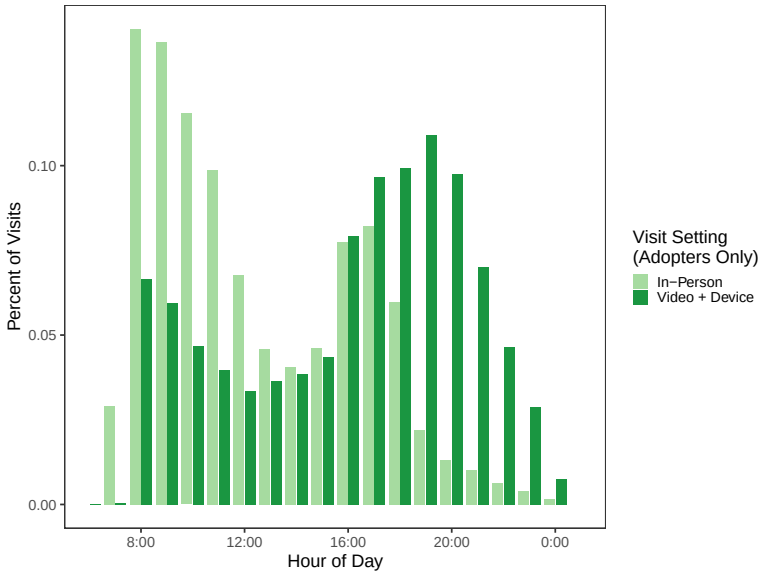


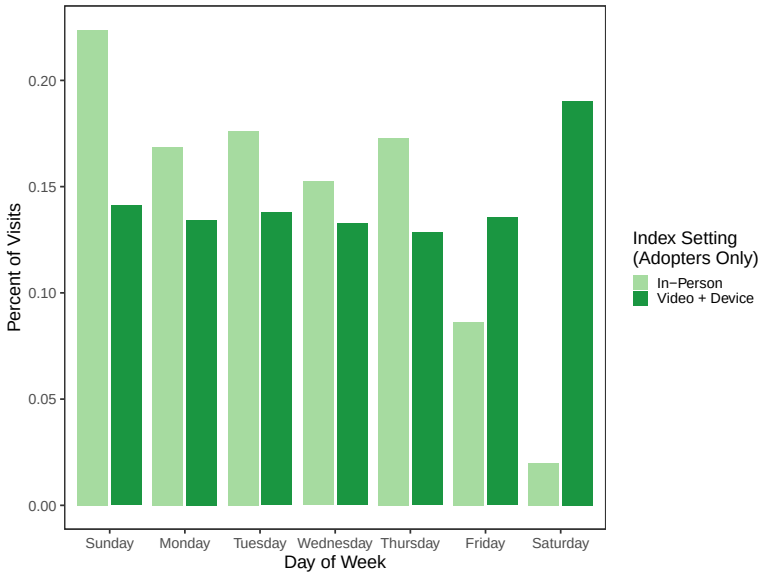
Figure shows the numbers of device-assisted visits over time. The sample consists of all device-assisted visits between November 2019 and October 2021.

Appendix Figure A3: Time of Day and Day of Week: Device vs. Non-Device Visits of Adopters

(A) Hour of Day

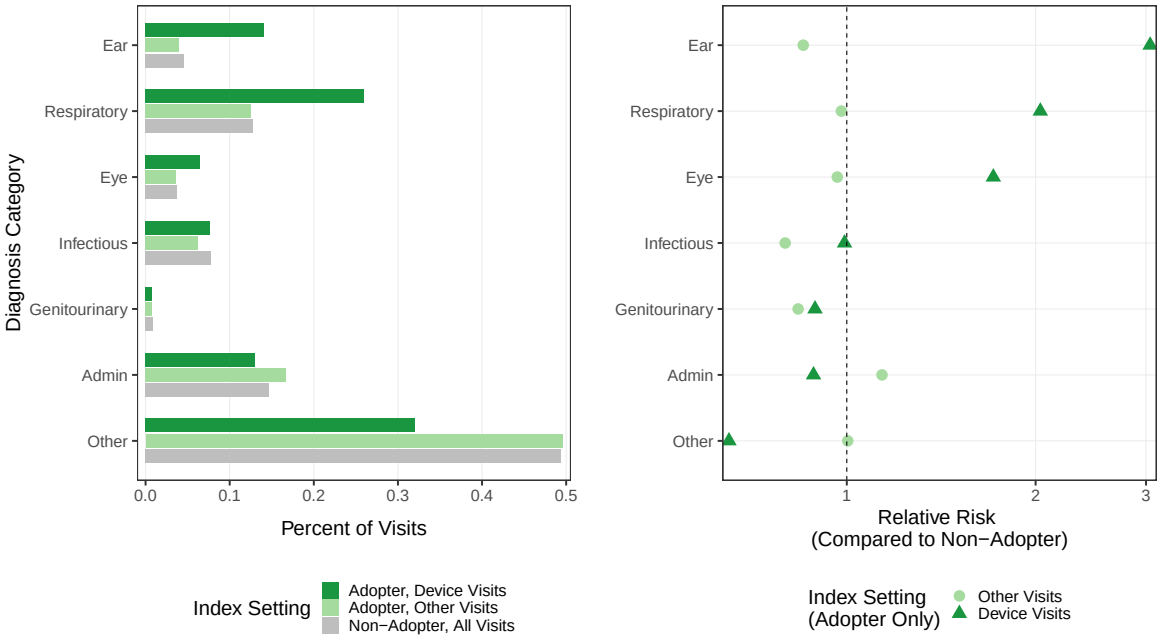


(B) Day of Week



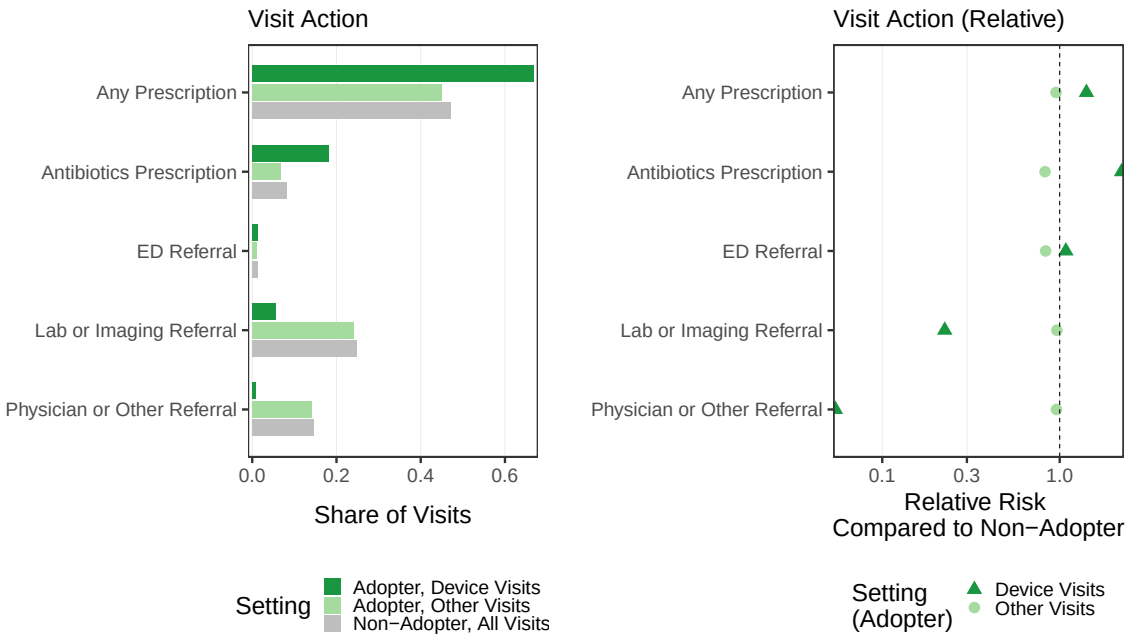
Device-assisted visits peak during weekends and after hours, when regular care is less available: 60% percent of device-assisted visits occur outside regular hours (7 a.m.–7 p.m. Sunday to Thursday, 7 a.m.–1 p.m. Friday), compared with only 16% of other primary care visit types (in-person, phone, and video visits).

Appendix Figure A4: Index Diagnosis in Device-Assisted Visits Versus Other Settings



The figure compares the distribution of diagnoses between device adopters and matched non-adopters in the first new primary care visit that occurred after at least 30 days without encounters after initial device adoption (or matched index visit). The left facet shows the frequencies of most common diagnoses as a percent of all visits of each type. The right facet shows the same frequencies relative to these of non-adopters. Adopter, Device Visits refer to new device-assisted video visits by adopters. Adopter, Other Visits, and Non-Adopter, All Visits refer to new primary care visits in all other settings (i.e., in-person, phone, and video visits) by adopters and non-adopters, respectively.

Appendix Figure A5: Physician Actions in Device-Assisted Visits Versus Other Settings



The figure compares the distribution of physician actions between device adopters and matched non-adopters in the first new primary care visit that occurred at least 30 days without encounters after initial device adoption (or matched index visit). The left facet shows the frequencies of most common actions as a percent of all visits of each type. The right facet shows the same frequencies relative to these of non-adopters. Adopter, Device Visits refer to new device-assisted video visits by adopters. Adopter, Other Visits and Non-Adopter, All Visits refer to new primary care visits in all other settings (i.e., in-person, phone, and video visits) by adopters and non-adopters, respectively.

Appendix Figure A6: The Impact of Device Adoption on Service Cost

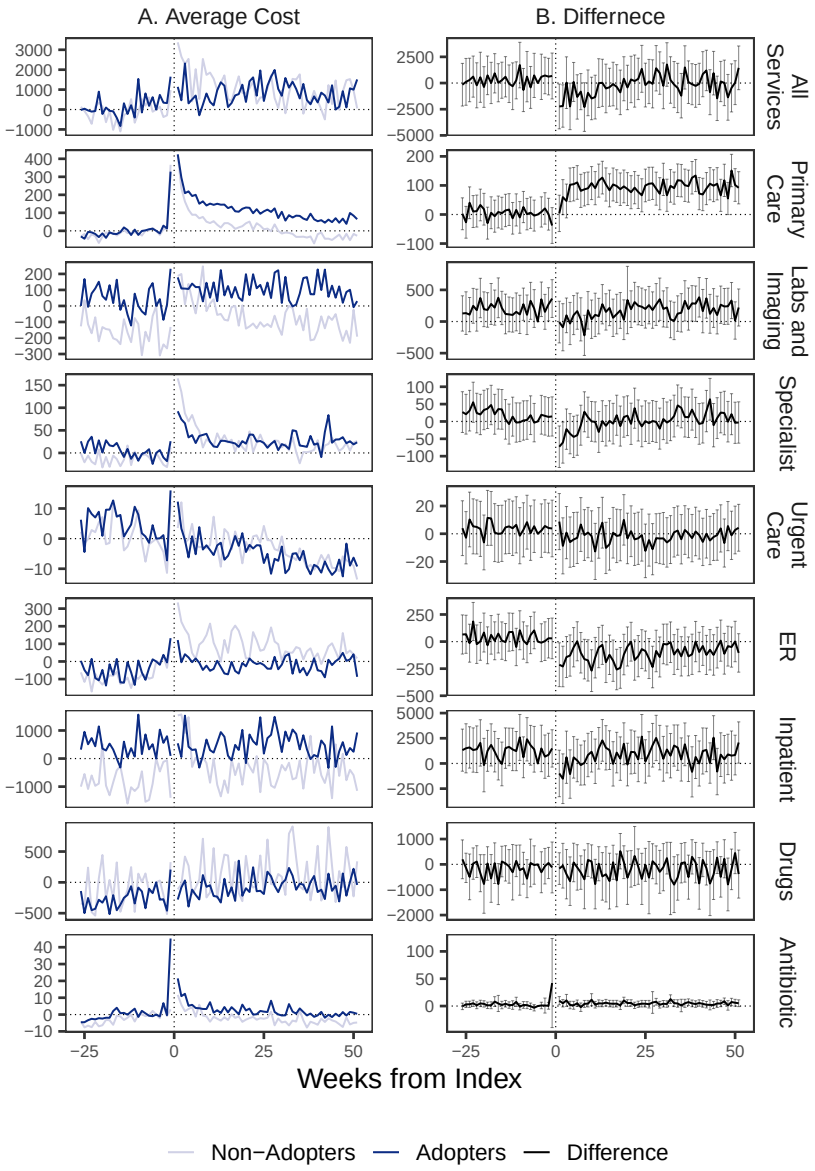


Figure shows estimates of the impact of device adoption on adopters' weekly cost of different services relative to matched non-adopters. Each row shows results for a different event type. Panel A shows the mean cost per member, residualized by patient and calendar-week fixed-effects. Panel B shows estimates of β_t from equation (1) and their 95% confidence intervals. The vertical dotted line denotes the index week 0, which is excluded. Urgent Care refers to urgent care center visits. ER refers to emergency room visits. Section 3 describes variable definitions in detail.

Appendix Figure A7: The Impact of Device Adoption on Utilization, Different Measures

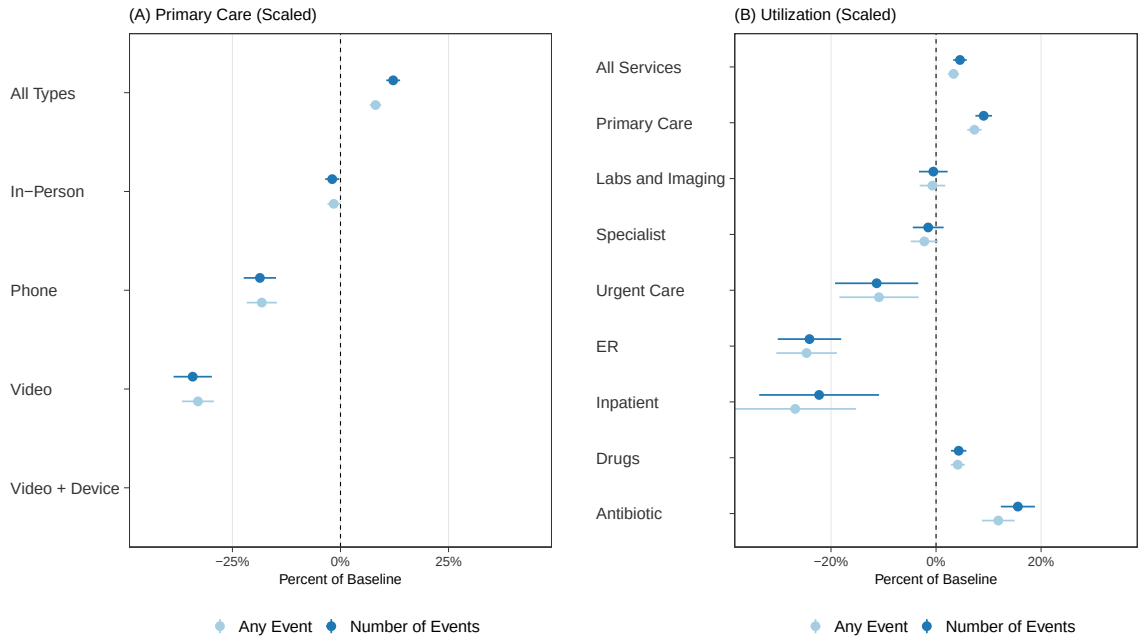


Figure shows the estimated impacts of device adoption on primary care visits (Panel A) and utilization of services (Panel B) using two alternative measures for utilization: the number of days with billed events in each week (dark blue) and an indicator for any utilization during the week (light blue). Each point represents the difference-in-differences estimate of the impact of device adoption (γ from equation (2)) for a different type of primary care visit, scaled by its baseline mean for adopters. Urgent Care refers to urgent care center visits. ER refers to emergency room visits. Section 3 describes variable definitions in detail.

Appendix Figure A8: The Impact of Device Adoption, Excluding COVID-19 Lockdowns

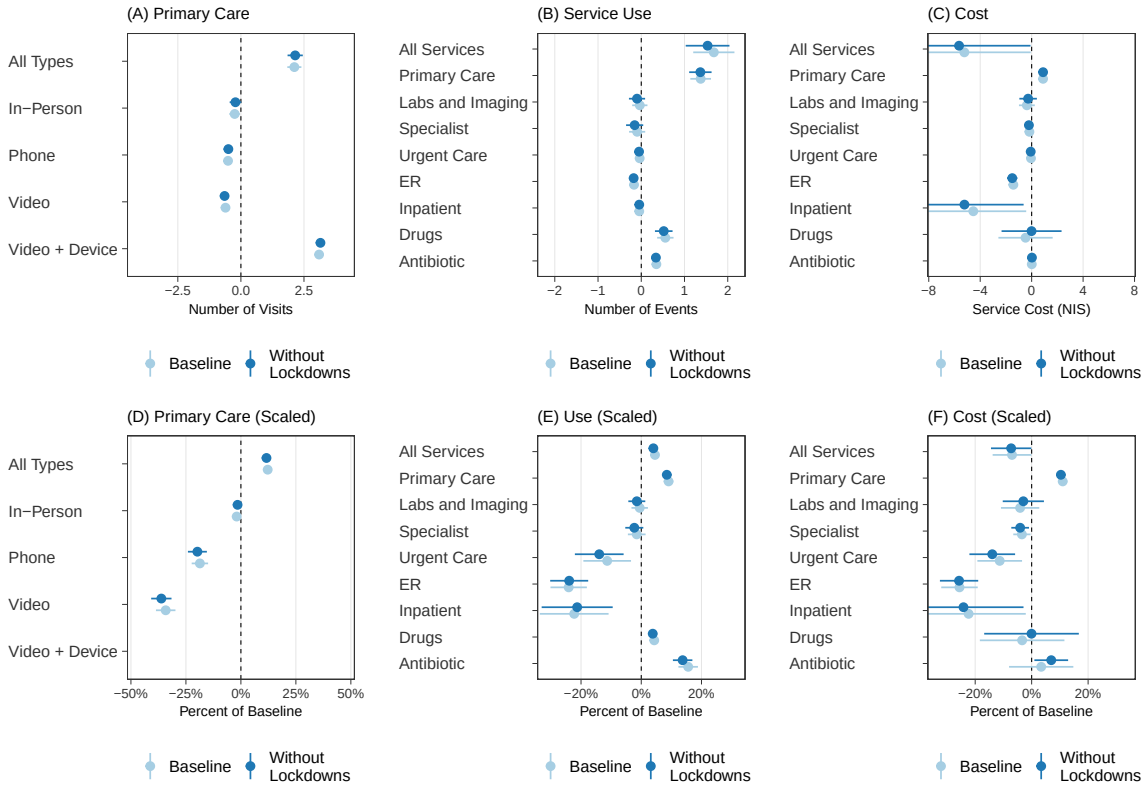


Figure summarizes robustness analyses which estimate equation (2) using the same baseline sample of adopters, but excluding from the measured outcomes all weeks during which Israel was under lockdown related to COVID-19 (Without Lockdowns, dark blue). Results for the baseline analysis that includes lockdown periods are reported in light blue for reference. Panels show results for different types of outcomes. The top panels show non-scaled results: the weekly number of primary care visits of each type (per 100 members), the weekly number of billing events for each service (per 100 members), and the weekly total cost per member (in NIS) for different services. The bottom panels show results as percentage of the pre-period mean of each outcome among adopters. Section 3 discusses the sample construction and variable definitions in detail. Appendix B.2 lists the dates of excluded lockdown period. Urgent Care refers to urgent care center visits. ER refers to emergency room visits. Section 3 describes variable definitions in detail.

Appendix Figure A9: The Impact of Device Adoption on Primary Care Visits by Patient Socioeconomic Status

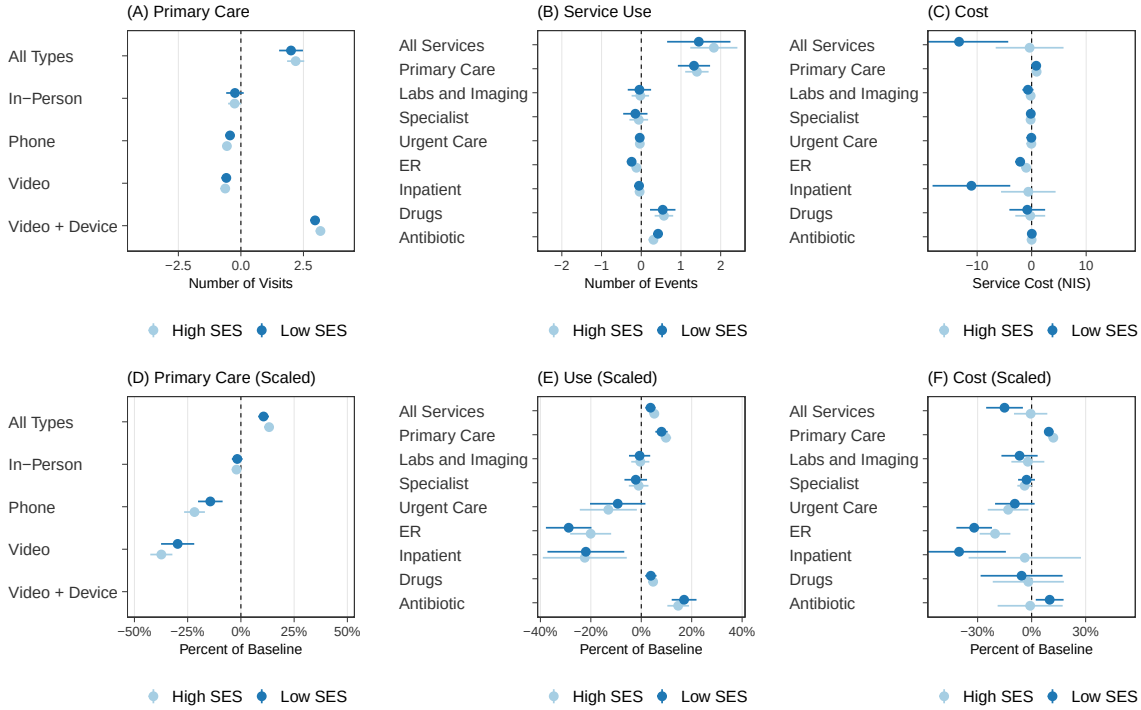


Figure shows the estimated impacts of device adoption on primary care visits for patients with above (dark blue) and below (light blue) median socioeconomic status, defined based on the patient's place of residence. Each point represents the difference-in-differences estimate of the impact of device adoption (γ from equation (2)) for a different outcome. Panels show results for different types of outcomes. The top panels show non-scaled results: the weekly number of primary care visits of each type (per 100 members), the weekly number of billing events for each service (per 100 members), and the weekly total cost per member (in NIS) for different services. The bottom panels show results as percentage of the pre-period mean of each outcome among adopters. Urgent Care refers to urgent care center visits. ER refers to emergency room visits. Section 3 describes variable definitions in detail.

Appendix Figure A10: The Impacts of Device Adoption Over Time

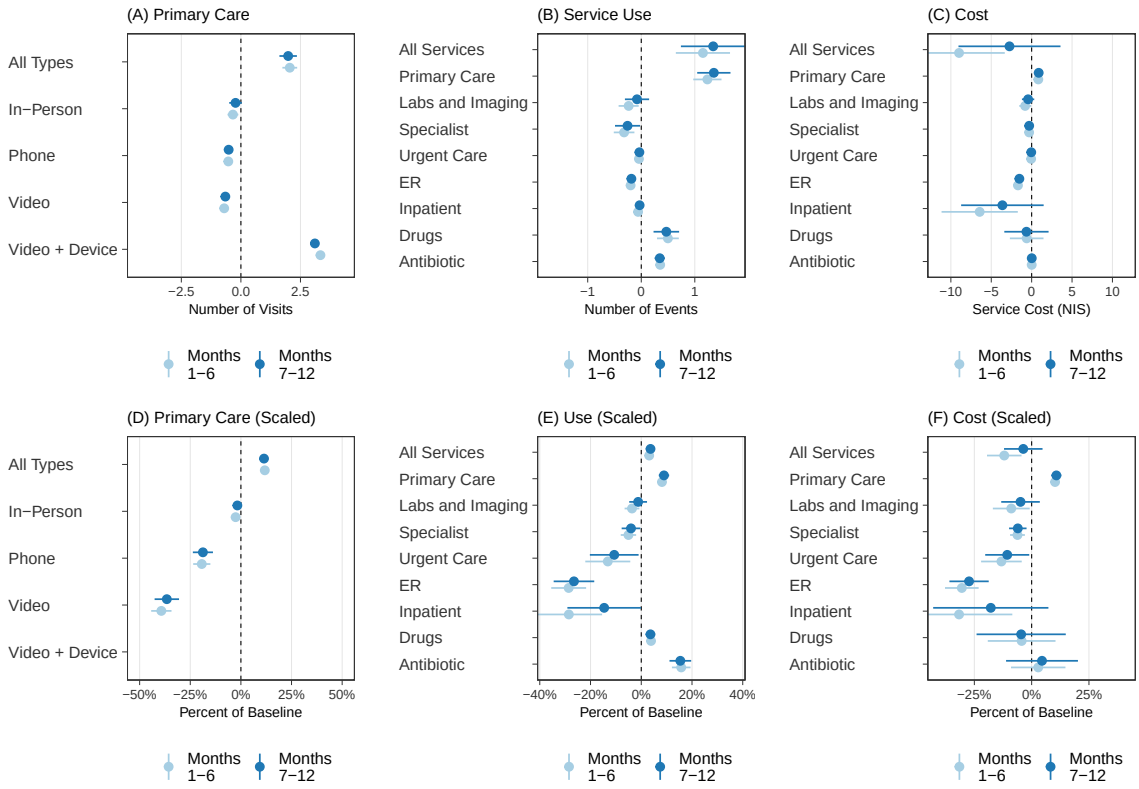


Figure shows the estimated impacts of device adoption on primary care visits (Panel A) and other types of events (Panel B) during the first (light blue) and second (dark blue) half of the year following the index. Each point represents the difference-in-differences estimate of the impact of device adoption (γ from equation (2)) for a different outcome. Panels show results for different types of outcomes. The top panels show non-scaled results: the weekly number of primary care visits of each type (per 100 members), the weekly number of billing events for each service (per 100 members), and the weekly total cost per member (in NIS) for different services. The bottom panels show results as percentage of the pre-period mean of each outcome among adopters. Urgent Care refers to urgent care center visits. ER refers to emergency room visits. Section 3 describes variable definitions in detail.

Appendix Figure A11: Distribution of Conditional Average Treatment Effects

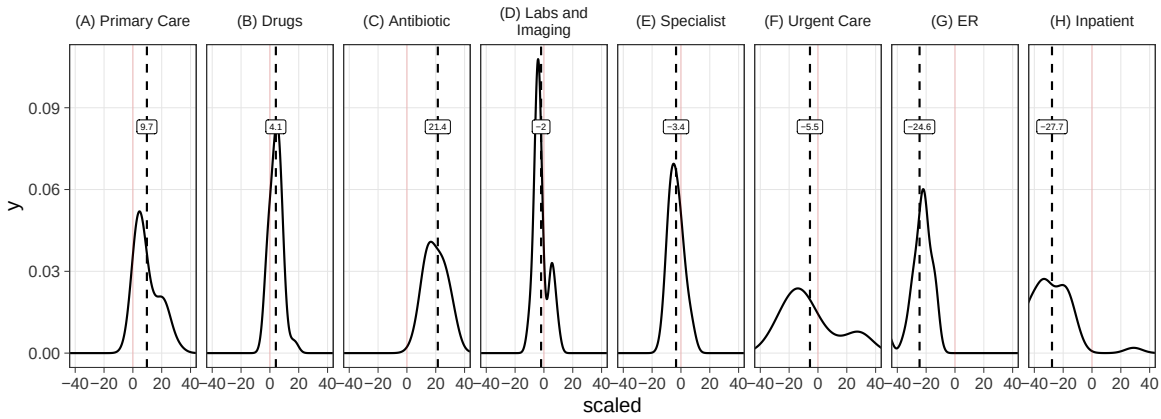


Figure shows kernel density estimates for the distribution of treatment effects across the partition of the main sample to subsets defined by the interaction of gender, age group, SES group, and an indicator for the patient having any chronic conditions. Estimates were obtained using a version of equation (2) that interacts the main effect with an indicator for each subgroup. The Impact is scaled by each outcome's baseline mean among adopters within each subsample. The kernel density estimates are weighted by subsample size. The vertical dashed line (and the boxed label above them) shows the weighted average of the conditional average treatment effect across all subsets. Urgent Care refers to urgent care center visits. ER refers to emergency room visits.

Appendix Figure A12: Online and Print Advertisements for the Device

(A) Online Advertisement for the Device

(B) Print Advertisement for the Device

A screenshot of an online landing webpage where HMO members can purchase the device for a discount. The Hebrew title reads: "Much more than a video call. Tyto: a kit for physician exams from home. No traffic. No waiting." The banner reads: "Now for a special discount of 179 NIS instead of 450 NIS". Source: `https://clalit.tytocare.com/tyto/care`. Accessed April 2023. The bottom panel shows a print advertisement by Clalit for the device in local media. Sourced from the newspaper website, at `https://www.yedhaifa.co.il/epapers/magazines/1506/`. Accessed April 2023. See Appendix A for translation of the text.

Appendix Table A1: Demographic Characteristics of Adopters and the General Population

	Adopters (1)	Non-Adopters (2)
A. Age Group		
Age	16.782	34.342
Median Age	6.000	32.000
0-2	0.172	0.033
3-5	0.289	0.083
6-18	0.158	0.198
19-45	0.321	0.346
45+	0.061	0.341
B. Demographics		
Female	0.544	0.524
High SES	0.624	0.339
Parent	0.337	0.473

The table shows summary statistics of 28,213 device adopters—members who used the device at least once (Adopters) and the same number of randomly sampled Clalit members who had not used the device by the end of our study period (Non-Adopters). Unlike in our main study sample, non-adopters in this table are not matched to adopters and are representative of the general Clalit population. High SES is an indicator for the patient residing in an above-median socioeconomic status geographic cluster. Parent is an indicator for the member having dependent children under coverage.

Appendix Table A2: Descriptive Summary of Main Outcomes

	Adopters	Non-Adopters
	(1)	(2)
A. Number of Primary Care Visits (per 100 Members per Week)		
All Types	19.8	19.4
In-Person Visit	11.4	11.7
Phone Visit	3.3	3.9
Video Visit	1.7	3.7
Video + Device Visit	3.5	0.0
B. Number of Events (per 100 Members per Week)		
All Services	39.6	39.9
Primary Care	17.0	17.5
Prescription Drugs	13.1	12.8
Antibiotics	2.6	2.2
Labs and Imaging	6.9	7.0
Specialist	6.5	6.7
Urgent Care	0.2	0.3
ER	0.7	1.0
Inpatient	0.2	0.3
Other	8.5	8.5
C. Cost (NIS)		
All Services	77.7	93.8
Primary Care	9.3	9.5
Prescription Drugs	13.9	16.9
Antibiotics	0.3	0.3
Labs and Imaging	9.8	10.4
Specialist	5.1	5.5
Urgent Care	0.4	0.5
ER	5.7	8.3
Inpatient	20.1	27.5
Other	13.8	15.7
Number of Matches	28,213	394,974

Table shows descriptive statistics for the main outcome measures for the main study sample of device adopters and matched non-adopters. Panel A shows data on the weekly primary care visits per 100 members. Panel B shows the percentage of members who utilized different services every week. Urgent Care refers to urgent care center visits. ER refers to emergency room visits. Panel C shows the average cost (in NIS) per member per week. For detailed variable defintions, see Section 3.

Appendix Table A3: Characteristics of Pediatric and Adult and High- and Low-Socioeconomic Status Subsamples

	Age				Socioeconomic Status			
	Adopters		Matched Non-Adopters		Adopters		Matched Non-Adopters	
	Pediatric	Adult	Pediatric	Adult	Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	3.68	37.95	3.67	37.92	17.36	16.37	17.35	16.36
Median Age	3.00	35.00	3.00	35.00	7.00	6.00	7.00	6.00
Female	0.492	0.628	0.492	0.628	0.545	0.543	0.545	0.543
High SES	0.637	0.602	0.637	0.602	0.000	1.000	0.000	1.000
Num of CC	0.40	2.13	0.38	2.18	1.20	0.97	1.20	0.99
ACG	0.54	1.13	0.50	1.05	0.84	0.72	0.77	0.67
PCP Visits in Prior Year	9.23	6.15	9.49	6.75	8.66	7.69	8.97	8.13
Total Cost in Prior Year	2,389	4,928	2,688	5,202	3,809	3,084	4,116	3,363
Number of Matches	17,463	10,750	244,389	150,585	10,616	17,597	148,675	246,299

Table shows descriptive statistics for different partitions of the main study sample of adopters and matched non-adopters that are used in heterogeneity analyses. Columns 1 and 2 show the subsamples obtained by partitioning the main study sample by age to pediatric (aged 0–18) and adult (19 and older) members. The partitioning is based on the age of the adopter. Columns 3 and 4 show the samples consisting of all corresponding (non-adopter) matches to the adopters in columns 1 and 2. Similarly, Columns 5 and 6 show the main study sample split by the adopter SES status, defined based on place of residence, and Columns 7 and 8 show the subsamples of corresponding matches. The variable High SES is an indicator for the patient residing in an above-median socioeconomic status geographic cluster.

Appendix Table A4: Subsamples Used for Estimating Heterogeneous Treatment Effects

SES	Gender	Any Chronic Condition	Age Group	Number of Adopters
(1)	(2)	(3)	(4)	(5)
Low	Male	No	Pediatric	2,167
Low	Male	No	Adult	400
Low	Male	Yes	Pediatric	1,028
Low	Male	Yes	Adult	1,237
Low	Female	No	Pediatric	2,285
Low	Female	No	Adult	564
Low	Female	Yes	Pediatric	858
Low	Female	Yes	Adult	2,077
High	Male	No	Pediatric	3,922
High	Male	No	Adult	735
High	Male	Yes	Pediatric	1,757
High	Male	Yes	Adult	1,630
High	Female	No	Pediatric	3,958
High	Female	No	Adult	805
High	Female	Yes	Pediatric	1,488
High	Female	Yes	Adult	3,302

The table lists the sizes of subsamples defined by the interaction of indicators for above (High) or below (Low) median socioeconomic status (SES), gender, an indicator for the patient having any chronic conditions, and age group (Pediatric: 0–17; Adult 18+). These samples were used for the analysis of heterogeneity in treatment effects that are discussed in Section 4.

Appendix Table A5: Avoidable Admissions

	Baseline Mean	Coeff	Stnd Error	% Change
	(1)	(2)	(3)	(4)
Baseline	0.208	-0.046	0.012	-22.3%
Unavoidable	0.157	-0.065	0.012	-41.2%
Avoidable	0.051	-0.013	0.007	-24.7%

Table shows the estimated impact of device adoption on different types of inpatient admissions, obtained from estimating equation (2) separately for avoidable and unavoidable admissions, defined based on the admission's ICD9 diagnosis codes. For details of the classification, see Appendix B.2. Coeff and Stnd Error are the estimated coefficient and standard error of γ from equation (2). % Change is the same coefficient divided by the baseline mean for the same outcome.