

Supplementary Material

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Changes in cough rate around the time of medical consultation

Figure 1: Diagram of time windows compared among participants who registered medical consultations

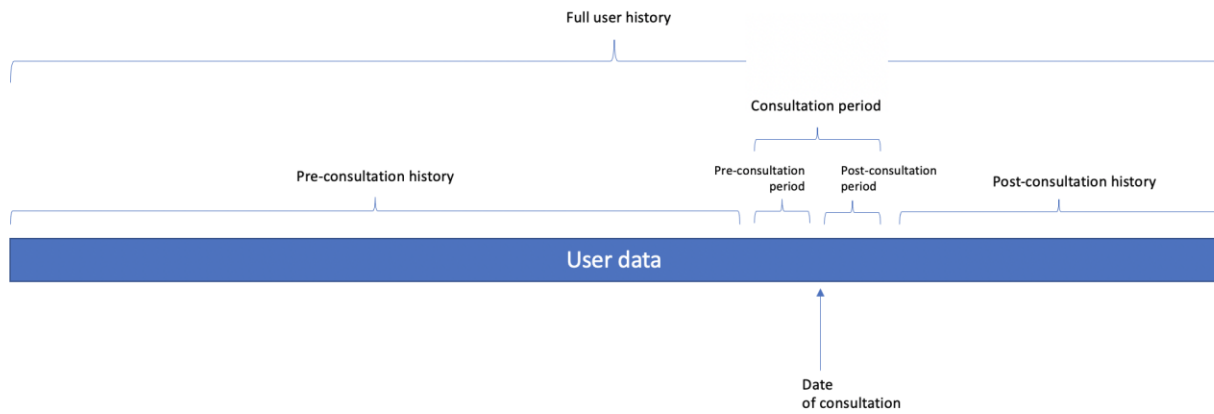
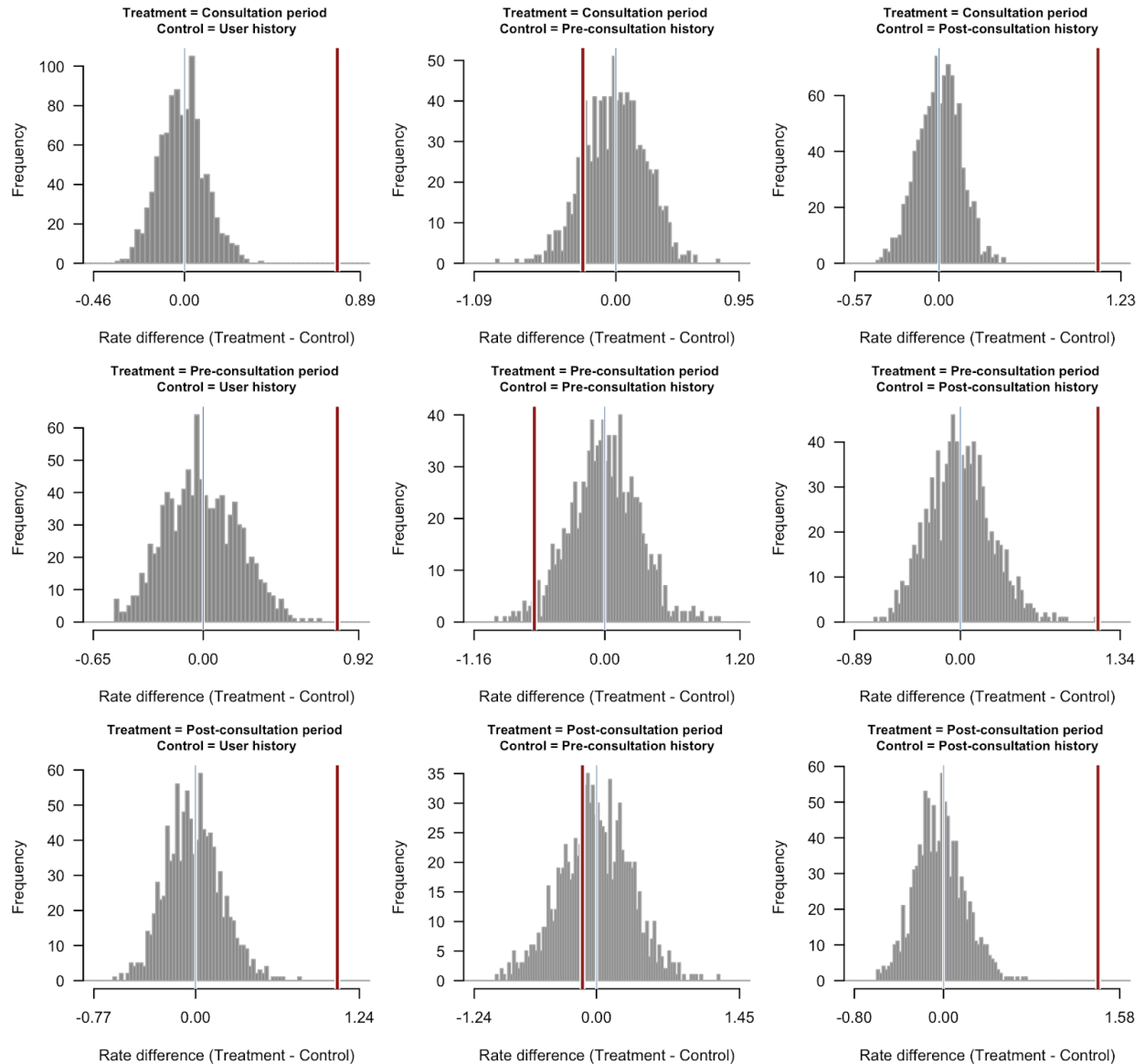


Table 1: Changes in cough rates during the two components of the consultation period

Compared groups (Day 0= Date of consultation)		n	Observed difference in cough rate (coughs/hour) Mean cough rate (SD)	p-value
Pre-consultation period (days -5 to -1)	Full user history	22	0.79 (3.24)	< 0.00001
	Pre-consultation history (before day -5)	18	-0.62 (1.80)	0.980
	Post-consultation history (after day+4)	19	1.15 (3.63)	< 0.00001
Post-consultation period (days 0 to +4)	Full user history	27	1.07 (2.91)	< 0.00001
	Pre-consultation history (before day -5)	18	-0.14 (2.41)	0.662
	Post-consultation history (after day+4)	25	1.38 (3.15)	< 0.00001

Figure 2: Observed cough differences compared with expected effect size distributions under the null hypothesis between different monitoring periods.



Results of the randomization analysis. Each pane represents the results of a single comparison test between the cough rates in a treatment period (e.g., consultation period) and a control period (e.g., remainder of user history). The grey histogram represents the distribution of differences expected under a null model of no pattern/random chance. These

distributions are centered about zero (white/blue line). The red line represents the actual difference observed. If the none (or very little) of the null distribution is bisected by the red line, that observation cannot be explained as a byproduct of random chance.

Table 2: Diagnoses associated with respiratory symptomatology in the studied cohort

Final diagnosis	n	%
Unspecified upper respiratory symptomatology	247	58.1
COVID-19	72	16.9
Contact with COVID-19 case	38	8.9
COVID-19 (follow up visits)	29	6.8
Tonsillitis	15	3.5
Sinusitis/rhinitis	10	2.4
Acute gastroenteritis	3	0.7
Chronic cough of unknown cause	3	0.7
Asthma crisis	2	0.5
Bronchial hyperresponsiveness	1	0.2
Allergic bronchopulmonary aspergillosis	1	0.2
Dyspnoea of unknown cause	1	0.2
GERD	1	0.2
Otitis	1	0.2
Pulmonary nodule under evaluation	1	0.2
Total	425	100.0

GERD: Gastroesophageal reflux disease.

Analysis of predictors of usage

Table 3: Descriptive statistics of the cohort

	N	Minimum	Maximum	Mean	Std. Deviation
Total visits	616	0	6	0.49	0.925
Total reminders	616	0	16	7.09	3.991
Female	616	0	1	0.65	0.478
Age	609	14	76	26.57	11.688
Self. Rep History of Resp. Disease	616	0	1	0.7	0.459
Total conditions reported	616	0	9	1.53	1.549

iOS/Android	616	0	1	0.56	0.497
Coughs	616	0	149.9289	2.066626	8.325265
Seconds of usage	616	791.1667	83298.09	20162.28	11257.28
Valid N (listwise)	608				

Table 4: Linear regression, dependent variable is seconds of application usage

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	11125.55	56419.49		0.197	0.844
Day of recruitment	0.065	1.273	0.002	0.051	0.959
Total visits	-23.211	419.821	-0.002	-0.055	0.956
Total reminders	307.431	103.268	0.11	2.977	0.003
Female	1370.449	810.428	0.059	1.691	0.091
Age	218.511	35.406	0.232	6.172	0.001
Self. Rep. Hist	780.591	1065.618	0.032	0.733	0.464
Total conditions	-441.354	319.359	-0.062	-1.382	0.167
iOS/Android	-6187.88	785.623	-0.278	-7.876	0.001
Coughs	368.685	47.471	0.28	7.767	0.001

Table 5: Causes of withdrawal among participants who completed the end-of-study questionnaire

Reason for withdrawal	Operating system			Total
	Android	iOS	Unknown	
Completion of requested period	20	3		23
Loss of interest	33	38	2	73
Privacy concerns	10	5		15
Technical issues	35	60		95
Other	3	2		5
Unknown	3	3		6
Total	104	111	2	217

Table 6: Response patterns observed in the heavy use group (over 100 hours monitored)

Key aspect	P1 (Female, Apple, 65 years)	P2 (Female, Android, 39 years)	P3 (Female, Android, 61 years)	P4 (Female, Android, 56 years)	P5 (Female, Apple, 36 years)	P6 (Male, Android, 35 years)	P9 (Male, Apple, 48 years)
Is cough important?	<ul style="list-style-type: none"> Depends if sick or not. Number less important than changes in trend. 	<ul style="list-style-type: none"> Not important Checks number out of curiosity. 	<ul style="list-style-type: none"> Relationship with smoking is important. Interest in increases with smoking. 	<ul style="list-style-type: none"> Important as it affects daily routines. Exact number not important but checks regularly. 	<ul style="list-style-type: none"> Not important. Number of coughs less important than trends. 	<ul style="list-style-type: none"> Only if repetitive or annoying. More important in the context of covid-19. 	<ul style="list-style-type: none"> Not important.
What worked?	<ul style="list-style-type: none"> Only records snippets. Automatic detection of cough. 	<ul style="list-style-type: none"> Simplicity Ability to access recorded cough sounds. Provides more information than other health apps. 	<ul style="list-style-type: none"> Continuous monitoring. Ability to detect changes related to smoking. 	<ul style="list-style-type: none"> Simplicity 	<ul style="list-style-type: none"> Notifications. Possibility of seeing changes in cough patterns. 	<ul style="list-style-type: none"> Ability to access recorded sounds. 	<ul style="list-style-type: none"> Simplicity and ease of use. Possibility of programming reminders and notifications. Easier to use than other health apps.
What did not work?	<ul style="list-style-type: none"> Regular crashes in iPhones. 	<ul style="list-style-type: none"> Irregular notifications and easy to forget. 	<ul style="list-style-type: none"> No complaints. Thinks the app works perfectly. 	<ul style="list-style-type: none"> Lags when checking old records. 	<ul style="list-style-type: none"> Regular crashes in iPhone. Monitoring interrupted without warning. Boring interface. 	<ul style="list-style-type: none"> The app catches other people's coughs. Inability to create different user profiles in one device. Need to activate it every day. 	<ul style="list-style-type: none"> It should start and stop automatically at certain times. High data consumption when not connected to Wi-Fi
What motivates?	<ul style="list-style-type: none"> Seeing changes in real time. 	<ul style="list-style-type: none"> Helping the research team. Curiosity. 	<ul style="list-style-type: none"> Providing valuable results. Seeing relationship with smoking. 	<ul style="list-style-type: none"> Seeing the effect of treatment on coughs. 	<ul style="list-style-type: none"> Regular notifications. Seeing changes in time. 	<ul style="list-style-type: none"> Collaborate with the research team. 	<ul style="list-style-type: none"> Personal commitment with the study.
Can monitoring improve health?	<ul style="list-style-type: none"> Gives an objective picture of progress. 	<ul style="list-style-type: none"> Only in people with resp. disease. 	<ul style="list-style-type: none"> It helps modify a damaging behaviour (smoking) 	<ul style="list-style-type: none"> Does not help because the cause of the cough remains unknown. 	<ul style="list-style-type: none"> Only in people with resp. disease or risk exposure. 	<ul style="list-style-type: none"> Additional information can help doctors. 	<ul style="list-style-type: none"> Only if provides recommendations

Table 6 (continued): Response patterns observed in the heavy use group (over 100 hours monitored)

Key aspect	P1 (Female, Apple, 65 years)	P2 (Female, Android, 39 years)	P3 (Female, Android, 61 years)	P4 (Female, Android, 56 years)	P5 (Female, Apple, 36 years)	P6 (Male, Android, 35 years)	P9 (Male, Apple, 48 years)
How to improve the app?	<ul style="list-style-type: none"> Correct regular crashes. 	<ul style="list-style-type: none"> Correct some details. 	<ul style="list-style-type: none"> Include medical recommendations. 	<ul style="list-style-type: none"> No suggestions. 	<ul style="list-style-type: none"> Make it more interactive. Increase automatization 	<ul style="list-style-type: none"> Program sessions to start automatically. Improve the algorithm to differentiate coughs from different people. Focus development on people with respiratory disease. 	<ul style="list-style-type: none"> Allow sessions to start and stop automatically. Include an option to only upload data using Wi-Fi networks.

Table 7: Response patterns observed in participants in the light use group (less than 100 hours recorded)

Key aspect	P7 (Female, Apple, 21 years)	P8 (Female, Android, 54 years)
Is cough important?	<ul style="list-style-type: none"> It's annoying, notices it when persists in time. Objective number is important to evaluate adequately. 	<ul style="list-style-type: none"> Not important Does not pay attention to frequency.
What worked?	<ul style="list-style-type: none"> Simplicity and accessibility. No need for extensive input from user. 	<ul style="list-style-type: none"> Simplicity and pretty design.
What did not work?	<ul style="list-style-type: none"> Very easy to forget to turn it on, particularly if busy or stressed. 	<ul style="list-style-type: none"> Not useful. Daily registries of cough and reminders were stressing. Need to remember to turn it on daily.
What motivates?	<ul style="list-style-type: none"> Interest in the study and potential utility in the covid-19 pandemic. 	<ul style="list-style-type: none"> Nothing. Not perceived useful.

Table 7 (continued): Response patterns observed in participants in the light use group (less than 100 hours recorded)

Key aspect	P7 (Female, Apple, 21 years)	P8 (Female, Android, 54 years)
Can monitoring improve health?	<ul style="list-style-type: none">• Provides accurate picture of impact in everyday life.	<ul style="list-style-type: none">• Only in people with resp. disease.
How to improve the app?	<ul style="list-style-type: none">• Program sessions to start and stop automatically.	<ul style="list-style-type: none">• Does not know.