

Strategies to Handle Increased Demand in the COVID-19 Crisis a Corona Telephone Hotline and a Web-based Self-triage System

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Abstract

Background

In emergencies, such as the COVID-19 pandemic, there is an increased need for contact with emergency medical services (EMS), and call volume might surpass capacity. Thus, the Copenhagen EMS in Denmark implemented a separate coronavirus hotline followed by a web-based self-triage system to reduce non-emergency call volume. The aim of this paper is to present the two measures implemented to handle the increased call volume to the Copenhagen EMS from those with mild or no relevant COVID-19 symptoms.

Methods

This is a cross-sectional observational study monitoring call volume in the first month of the COVID-19 pandemic in accumulated call numbers, compared to the equivalent numbers during one month from the year before (2019). A coronavirus hotline and web-based self-triage system are presented in absolute numbers of users.

Results

In the first month of the COVID-19 pandemic in Copenhagen, emergency medical dispatch centers were extensively overloaded with more than 10,800 calls, resulting in significantly prolonged queue time (mean time in minutes: 12:02; CI: 11:55-12:09) compared to 2019 (mean time in minutes: 02:23; CI: 02:22-02:25) and thereby limiting access to emergency assistance and triage for citizens. The introduction of the coronavirus hotline showed reduced call volume and queue time to the EMS. The web-based self-triage system was used more than 107,000 times. However, no correlation between call volume and the use of a web-based self-triage system was observed.

Conclusions

Creating a coronavirus hotline staffed by healthcare personnel seemed to have an impact on call volume and potentially relieved the strain in resources, while the web-based self-triage system was widely used and could be further developed to reach its full potential. Other EMS organizations can implement these measures to enhance capacity in a future epidemic.

Method

This investigation is a cross-sectional observational study examining the effect of implementing a coronavirus hotline and WBSTS on EMS call volume.

Setting

The Capital Region of Denmark, Copenhagen, has 1.8 million inhabitants served by the Copenhagen EMS. The Copenhagen EMS is an integrated health care service comprised of an emergency medical dispatch call center, ambulance service and physician- and paramedic-staffed mobile critical care units. The Copenhagen EMS is accessed through two main numbers, namely, 1-1-2 (the European emergency number) for life-threatening emergencies and 1813 (medical helpline) for all other urgent medical issues, including access to emergency departments. Both lines manage and triage all urgent hospital admissions and as gateway to all hospital contact central components of the health care system. The 1813 medical helpline receives approximately 1,800 calls on weekdays and 3,500 calls daily on weekends. Each caller is triaged to either advice, admission to the emergency department (including booking a time slot), direct hospitalization, dispatch of ambulance response or home-visit by a physician.

The Coronavirus hotline

The hotline was launched on March 4, 2020, as a separate queue system and was established as a stand-alone call center on March 9. The hotline was staffed by 5–18 persons at peak, all with a healthcare-related educational background (e.g., nurses, medical students, medical doctors). The staff was instructed to follow a protocol resulting in the algorithmic placement of responses (Fig. 1). The caller could eventually be given advice on actions or self-isolation or be directed to the emergency EMS line for triage.

All callers who contacted the 1813 medical helpline were presented with the option to either go to the coronavirus hotline if they were calling concerning COVID-19 or continue to the normal EMS if their call concerned other emergent medical issues (Fig. 1). All calls regarding life-threatening emergencies were directed to call the 1-1-2 emergency line.

Insert the following here: Fig. 1. Flowchart for the coronavirus hotline

Development of the Web-based Self-Triage System

The development of the WBSTS was initiated on March 12, and the system was ready to launch only three days later. A simple algorithm based on the triage of potential COVID-19-infected patients (Fig. 2) was designed and implemented as an online web application for inclusion on the already-established Copenhagen EMS webpage and initiated on March 15.

Insert the following here: Fig. 2. Flowchart for the initial web-based self-triage system

Dissemination of the coronavirus hotline and the WBSTS

Awareness of the WBSTS and the coronavirus hotline was initially disseminated to the public through a press release by the Copenhagen EMS, the Capital Region and the websites and social media channels (Twitter® and Facebook®) of hospitals in the region.

Data collection

Data were collected from February 26, 2020, to March 27, 2020, for all calls to the 1-1-2 emergency line and 1813 medical helpline, and for the WBSTS. The data was stratified by the access number used, i.e., the 1-1-2 emergency line, the 1813 medical line and the coronavirus hotline. Data regarding caller demographics and

referrals were obtained by the Copenhagen EMS dispatch system. All data were obtained via the Copenhagen EMS line audits

Statistics

Descriptive analyses were performed. Absolute numbers and percentages for variables were reported. Comparative analyses were performed using chi-square tests and Student's t-tests. A calculation was performed using ANOVA for the comparison analysis. All analyses were performed using SAS Statistical Enterprise Software, version 7.11.

Ethics

We followed the General Data Protection Regulation and registered the study with the Danish Data Protection Agency (journal number P-2020-343). The study was approved by the Danish Patient Safety Authority (journal number 31-1521-267). The Research Ethics Committee in the Capital Region of Denmark waived the need for ethical approval (journal number 20026743).

Results

On February 27, 2020, Denmark had the first confirmed case of COVID-19 (indicator patient). The Danish health care authorities observed a steep rise in the number of confirmed cases, with a daily doubling in the number of cases from March 8–11. On March 12, the strategy officially changed from containment and suppression to mitigation and preparation. On March 14, the first official mortality due to COVID-19 was confirmed.

The EMS call volume

Overall calls volume for Copenhagen EMS was increased by 24% in the period, mostly to the coronavirus hotline. An increase in the EMS call volume for 1813 calls (excluding the coronavirus hotline) from the first confirmed case in Denmark on February 27, 2020, until one month later March 27, 2020, was not observed compared to the same period in 2019.

The EMS 112 emergency line received 8,870 calls in 2020 compared to 8,494 in 2019, and the 1813 medical helpline received 84,317 in 2020 compared to 84,176 in 2019 (Table 1) from February 26 until one month after. There was a difference in the age of the callers (a mean of 53.0 years in 2020 and a mean of 53.6 years in 2019). Similarly, minor but not clinically relevant differences can be observed for the 1813 medical helpline (Table 1). There was no apparent difference in the relative distribution of call volume by day or day of the week (Table 1).

Table 1
Demographics of EMS calls from February 27 to March 27, 2020

	1-1-2 Emergency line		P	1813 Medical helpline		P	Corona hotline
	2019 (n=8,494)	2020 (n=8,870)		2019 (n=84,176)	2020 (n=84,317)	2019 vs 2020	2020 (n=21,063)
Mean age, years (95% CI)	53.6 (53.0-54.2)	53.0 (52.4-53.6)	<.0001	32.7 (32.6-32.9)	33.7 (33.5-33.9)	<.0001	33.8 (33.6-34.0)
Male (n (%))*	3,798 (51.5)	4,082 (51.8)	.5149	38,432 (46.4)	39,922 (46.5)	.5100	8,824 (49.7)
<u>Time of day</u>							
07:00-14:59	3,526 (41.5)	3,439 (38.7)	.0002	28,231 (33.5)	28,182 (32.4)	.0052	7,011 (33.3)
15:00-22:59	3,304 (38.9)	3,666 (41.3)	.0011	44,913 (53.3)	46,183 (53.0)	.0102	11,739 (55.7)
23:00-06:59	1,664 (19.6)	1,765 (19.9)	.9181	11,138 (13.2)	12,697 (14.6)	<.0001	2,313 (11.0)
<u>Day of week</u>							
Weekdays	6,193 (72.9)	6,277 (70.8)	<.0001	51,712 (61.4)	55,031 (63.2)	<.0001	15,113 (71.8)
Weekends	2,301 (27.1)	2,593 (29.2)	<.0001	32,570 (38.6)	32,031 (36.8)	<.0001	5,950 (28.2)
Mean queue time, 95% CI [mm:ss]	00:05 (00:05-00:05)	00:05 (00:05-00:05)	.6605	02:23 (02:22-02:25)	12:02 (11:55-12:09)	<.0001	13:46 (13:29-14:02)
Mean talk time, 95% CI [mm:ss]	03:20 (03:18-03:22)	03:40 (03:37-03:42)	<.0001	03:58 (03:57-03:59)	04:33(04:32-04:34)	<.0001	03:39 (03:37-03:42)
<u>Response</u>							
Emergency, lights and sirens	6,517 (78.4)	6,279 (73.3)	<.0001	3,526 (4.2)	3,066 (3.6)	<.0001	79 (0.4)
Emergency, not transported	1,487 (17.9)	1,953 (22.8)	<.0001	361 (0.4)	297 (0.4)	.0124	6 (0.0)
Self-care/GP**	28 (0.3)	42 (0.5)	.1509	37,329(44.3)	48,827 (58.0)	<.0001	14,387 (94.3)

Referred to ED	253 (3.0)	254 (3.0)	.6850	28,973 (34.4)	18,110 (21.5)	<.0001	335 (1.6)
Hospitalized	25 (0.3)	42 (0.5)	.0659	6,393 (7.6)	6,805 (8.1)	<.0001	306 (1.5)
* Of contacts with known gender							
** Those who were not referred to the hotline are assumed to have concluded with self-care							

However, since the introduction of the coronavirus hotline on March 4, 2020, a large number of calls to the EMS were forwarded to the specific coronavirus hotline. The coronavirus hotline received a total call volume of 21,063 calls in this period (Table 1) and had mean queue times of 13 minutes and 46 seconds (Table 1).

Insert the following here: Table 1. Demographics of EMS calls from February 27 to March 27, 2020

The call volume on the coronavirus hotline peaked on March 12, with approximately 2,100 calls in one day. Furthermore, 4,409 (20.9%) of the calls to the coronavirus hotline were redirected to the EMS 1813 medical helpline; these calls were to be further assessed and triaged by a physician.

Hence, in total, a significant ($P < 0.001$) increase in the total EMS call volume was observed, most extensively from March 2–15 but was mitigated by the implementation of to the coronavirus hotline (Fig. 3). After day 19 (March 15), a minor decrease in total call volume was witnessed on both the 1813 medical helpline and the specific coronavirus hotline (Fig. 3).

Insert the following here: Fig. 3. Accumulated call volumes and web-based self-triage system use

EMS queue time

Although call volume is seemingly not substantially higher once the capacity is overloaded, the EMS queue time is the first marker and will rise steeply. The limited capacity of the EMS 1813 medical helpline is seen to be significantly overloaded in this period, with significantly higher queue time than in 2019. In 2020, the mean queue time was 12 minutes and 2 seconds (CI: 11:55 – 12:09), which is significantly ($P < 0.001$) higher than the two minutes and 23 seconds (CI: 02:22 – 02:25) observed in 2019 (Table 1). Several periods with a maximum queue time of up to 2 hours was noted in the very peak of the corona burden prior to implementation of the coronavirus hotline.

Several peaks in queue time are notable on the EMS 1813 medical helpline, most notably on March 1, 8–9, 11–12 and 15 (Day 4, 11–12, 14 – 5 and 18 in Fig. 4). The calls forwarded to the coronavirus hotline had a similar peak pattern after the implementation, except for the initial peak on March 1 prior to implementation (Fig. 4). The increase in queue time is due to not only an increase in call volume but also an increase in time for call handling (conversations are longer by approximately 1 minute).

Several events coincide with peaks in queue time, notably a slow peak in queue time in the days after the announcement of the first confirmed patient (see Fig. 4).

Insert the following here: Fig. 4. Queues for EMS lines and key events around the Danish COVID-19 impact

Use of the WBSTS

The WBSTS was implemented on March 15 and was included on the Copenhagen EMS webpage. In the first month, the WBSTS was used 107,894 times. A total of 92.2% of users completed all questions on the WBSTS, and 14.6% marked that they had respiratory distress (Table 2).

Table 2
Demographics of web-based self-triage system users

Users (n)	107,894
Age (median, IQR)	42 (31-54)
Sex, n (%)	
Male	10,117 (40.7)
Female	14,766 (59.3)
Gender missing	83,011
Time of day, n (%)	
07:00-15:00	34,971 (32.4)
15:00-23:00	61,627 (57.1)
23:00-07:00	11,296 (10.5)
Weekday/weekend, n (%)	
Weekday	66,935 (62.0)
Weekend	40,959 (38.0)
Zip code (within the capital region), n (%)	
Copenhagen	11,952 (49.6)
Other	12,169 (50.4)
Outcomes	
Completed webtriage, n	88,254
Initially reported pain and breathing difficulty, n (%)	14,494 (16.4)
Responses, n (%)	
Call 1813 or GP	35,956 (40.7)
Advised to self-isolate	31,112 (35.3)
Not COVID-19	21,186 (24.0)

A total of 24,883 users provided information and feedback for the system. Among the users agreeing to provide feedback, 80% found the system satisfactory, and 20% did not. The median age for users was 42 (IQR 31–54), with more female users (59%). The WBSTS had more users in the daytime than at night. Of the three possible types of advice that could be offered, the WBSTS advised 24.0% (21,186 calls) of users that they had

reported symptoms of COVID-19, 35.3% (31,112 calls) of users were advised to self-isolate, and 40.7% (35,956 calls) were advised to call the EMS and coronavirus hotline. No correlation between EMS call volume and use of the WBSTS could be documented.

Insert the following here: Table 2. Demographics of web-based self-triage system users

Discussion

Main results

This study found increasing call volume to the EMS during the beginning of the national COVID-19 pandemic. The queue time for both the 1813 medical helpline and the designated coronavirus hotline increased markedly during the first month of the impact of COVID-19 in Denmark to a mean of 12 minutes and 2 seconds in 2020, compared to an average of 2 minutes and 23 seconds in 2019. However, the impact was drastically reduced using a specific healthcare-staffed coronavirus hotline to forward all calls regarding the ongoing pandemic. In peak periods, the coronavirus hotline had a call volume that was similar to that of the EMS 1813 medical helpline and thus relieved the burden; the 1813 call volume returned to operating capacity after the burden was cut almost in half.

Using a target healthcare-staffed hotline to relieve the EMS burden

A 2009 nurse-staffed and American-based flu hotline created by the Centers for Disease Control (CDC) had the same aim of reducing call volume to the EMS [13]. One of the unresolved questions in the publication was whether the alternative call lines played a prominent role in a pandemic response to meet patients' needs and reduce the surge in healthcare facilities [13]. In Copenhagen, the coronavirus hotline managed almost the same number of calls as the EMS in the peak of the surge around March 11. Without the coronavirus hotline, the EMS would have been overwhelmed with an extensive line queue and, consequently, potential missed calls and delayed EMS or hospital responses, possibly leading to psychological barriers that cause callers to avoid contact.

Web-based self-triage

Another measure to reduce the strain on the EMS that differs from the CDC flu line was the establishment of the WBSTS. The WBSTS was widely used with more than 107,000 users from its launch until March 27. However, no apparent effect on call volume is indicated or documented. Users were mainly younger adults (median 44 years, IQR 31–54 years). The WBSTS was limited in interaction, and as expected, not all symptoms were presented; consequently, some potentially infected persons could have been missed [1, 17–18]. The authors find that the WBSTS might run the risk of being too simple to be useful for some users (20%). Furthermore, without revisions, some citizens might not trust the answers due to the simplicity and rigidity of the first version. For subsequent updates and revisions, the authors find it relevant to examine user engagement [19]. However, the central merit of a user WBSTS is that it can be developed and implemented in a matter of days to provide instant relief for EMS lines and offer relevant advice to citizens who are not in need of triage or healthcare advice beyond self-isolation or a test of symptoms. We found that 85.4% of WBSTS

entries presented with mild or no relevant symptoms, and a proportion of these entries could have potentially overloaded the EMS (accounting for up to 92,141 additional calls). A similar WBSTS created for the 2009 influenza pandemic was designed with an expert panel and several revisions and was furthermore based on recurrent data in hospitalizations [15].

Development of a chatbot as an addition to the Copenhagen EMS call center

The perspectives are explicitly to evaluate the effort and further develop an actual active “chatbot” to relieve the EMS of cases with no or mild symptoms and the corona helpline by providing counseling for common questions to improve triage without impeding access for those in need. A “chatbot” is defined as an “artificial intelligence program designed to simulate human conversation via text or speech”, as opposed to the current flowchart model [20–21]. The use of chatbots has seen a growing development and usage within the medical literature [21–22], with successful application for recording key symptoms [23–26].

Perspectives and epidemiological surveillance

The early detection of viral disease outbreaks prior to widespread endemics is necessary to initiate measures to limit the prevalence and mortality [27–29]. Several benefits that can help ease and alleviate the monitoring process by delivering low-cost intuitive and adaptable systems. Web-based systems provide increased transparency and may allow earlier detection of disease outbreaks at a reduced cost [30–31].

Strengths and limitations of the study

A strength of this study is the large amount of data and the richness of personal information of EMS users in Denmark in general. Another strength of the study is that the speed of the implementation of these emergent initiatives ensured reliable data in the very early phase of the EMS call surge. However, this study has severe limitations, and the data must be interpreted with caution and used for inspiration. In contrast to a randomized trial, this study cannot assume that the callers and users of web-based self-triage would not call or use the WBSTS if these initiatives had not been communicated to the public. If public knowledge of these initiatives did indeed create the observed additional volume by implication of the public awareness of the initiatives, the effect is moderate at best. However, we find that very recent data from the Italian EMS present a situation in which call volume did rise threefold; hence, it is somewhat logical to expect the burden to be “real”. Furthermore, the data collected and presented on the WBSTS have several uncertain characteristics, including the inability to portray multiple uses by the same persons and whether users completed the WBSTS.

As such, the conclusions of this study on the effect of caller volume are severely limited by several potentially important uncontrolled factors.

Conclusion

In the first month of the COVID-19 pandemic in Denmark, the emergency medical dispatch center in Copenhagen was extensively overloaded, resulting in prolonged queue time and thereby limiting access to emergency help and triage for citizens. The Copenhagen EMS developed and implemented a coronavirus hotline and a web-based self-triage system to reduce nonemergency call volume on the emergency medical

dispatch centers. The introduction of the coronavirus hotline showed reduced call volume and queue time to the EMS 1813 medical helpline. Other EMS systems can implement these emergent measures to enhance capacity and potentially use them as early warning tools to help monitor future epidemics.

Abbreviations

COVID-19

coronavirus disease 2019

EMDC

emergency medical dispatch center

WBSTS

web-based self-triage system

EMS

emergency medical services

WHO

World Health Organization

Declarations

Ethics approval and consent to participate

We followed the General Data Protection Regulation and registered the study with the Danish Data Protection Agency (journal number P-2020-343). The study was approved by the Danish Patient Safety Authority (journal number 31-1521-267). The Research Ethics Committee in the Capital Region of Denmark waived the need for ethical approval (journal number 20026743). All data was aggregated anonymous data and informed consent was not relevant in current study.

Consent for publication

Not applicable

Availability of data and materials

Data are available upon reasonable request. Please email the corresponding author to request the relevant data. Please provide the authors of the article with a detailed protocol for the proposed study and supply information about the funding and resources to conduct the study. If appropriate, invite the original author[s] to participate in the re-analysis. If a month elapses without a response from the authors, please email the editorial office.

Competing Interests

None of the authors has a financial conflict of interest.

The Copenhagen Emergency Medical Services have received unrestricted research grants from the Laerdal Foundation. The TrygFoundation has supported a large number of projects. The Copenhagen EMS has received a research grant from Novo Nordisk Foundation to develop a chatbot based on artificial intelligence computing. None of these occurrences has influenced data collection, data processing, or the analysis or interpretation of data.

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Author contributions

All authors agreed on the study setup, data collection and analysis. TJ, the first author, was involved in the data collection and drafted the manuscript along with MGH, MSJ, SNB and HCC. SNB performed all data processing and analysis. All authors were involved in the critical review of the manuscript.

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Figures

Figure 1. Flowchart for the coronavirus hotline

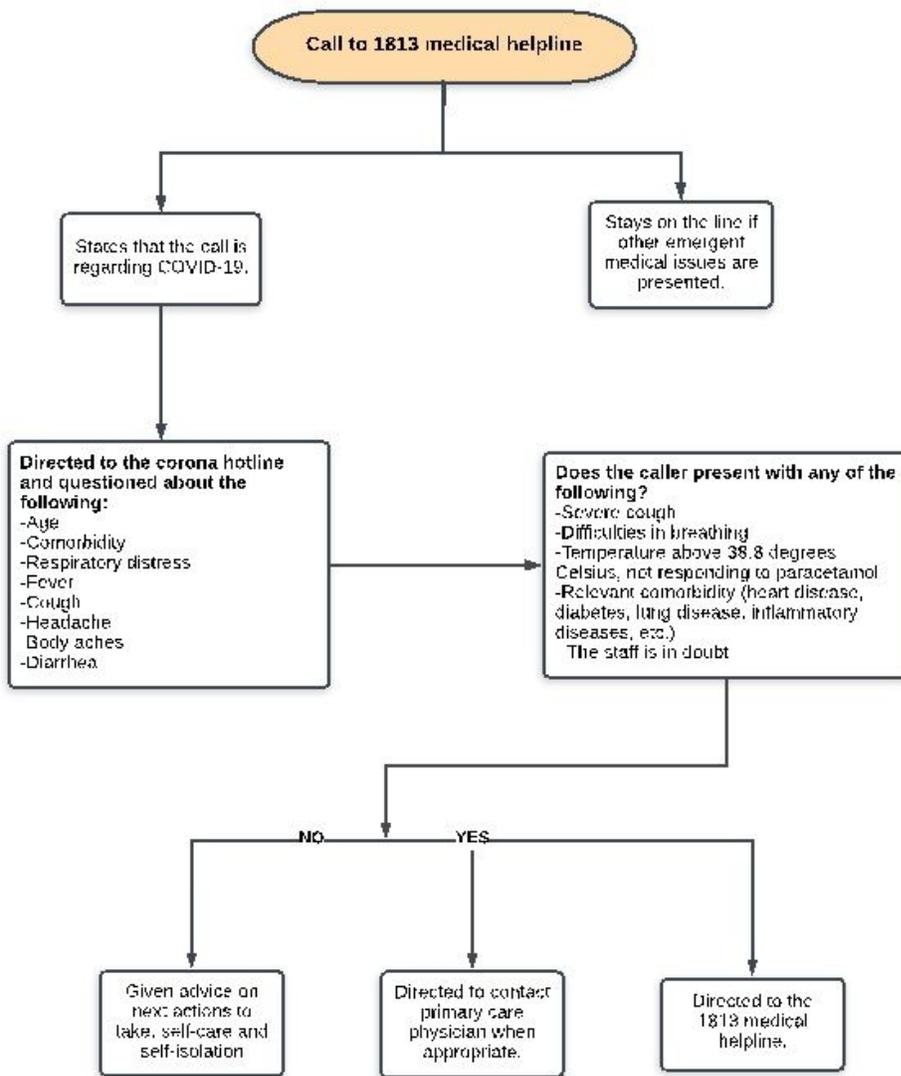


Figure 1

Flowchart for the coronavirus hotline

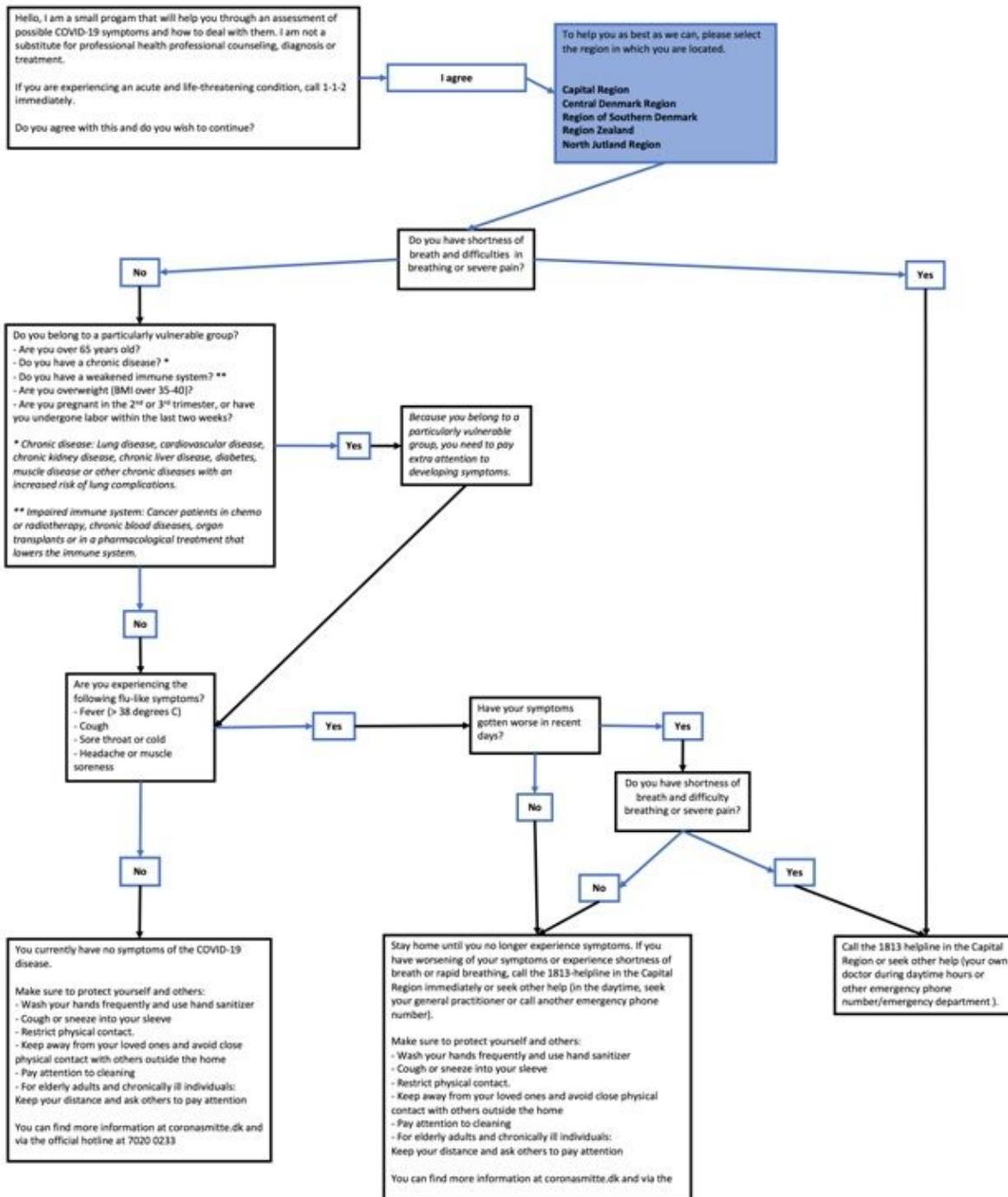
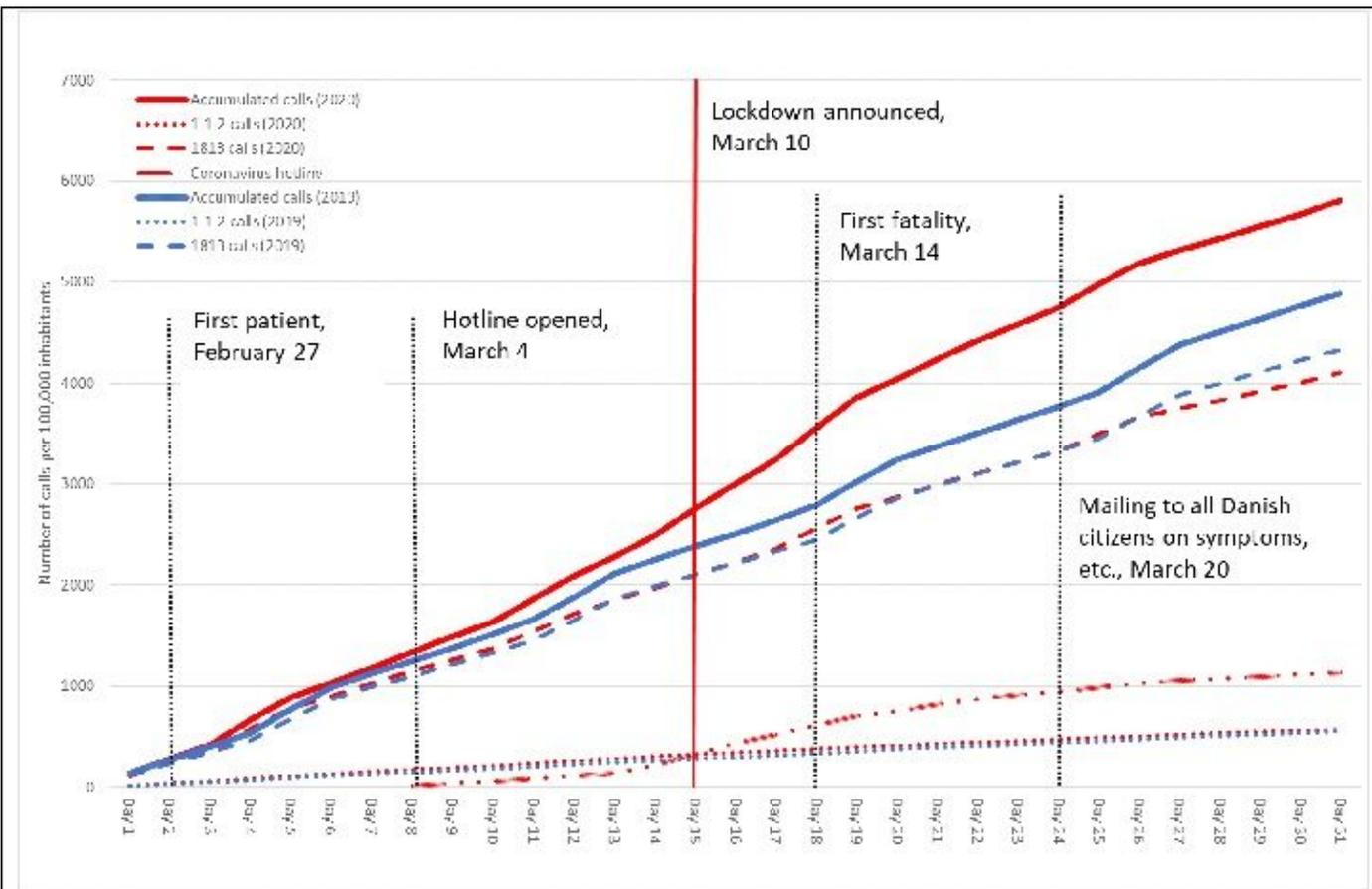


Figure 2

Flowchart for the initial web-based self-triage system



Call volume [number of calls] for the 1813 medical helpline, the 1-1-2 emergency line and the COVID helpline from February 26 to March 27, displayed for 2020 and 2019.

Figure 3

Accumulated call volumes and web-based self-triage system use

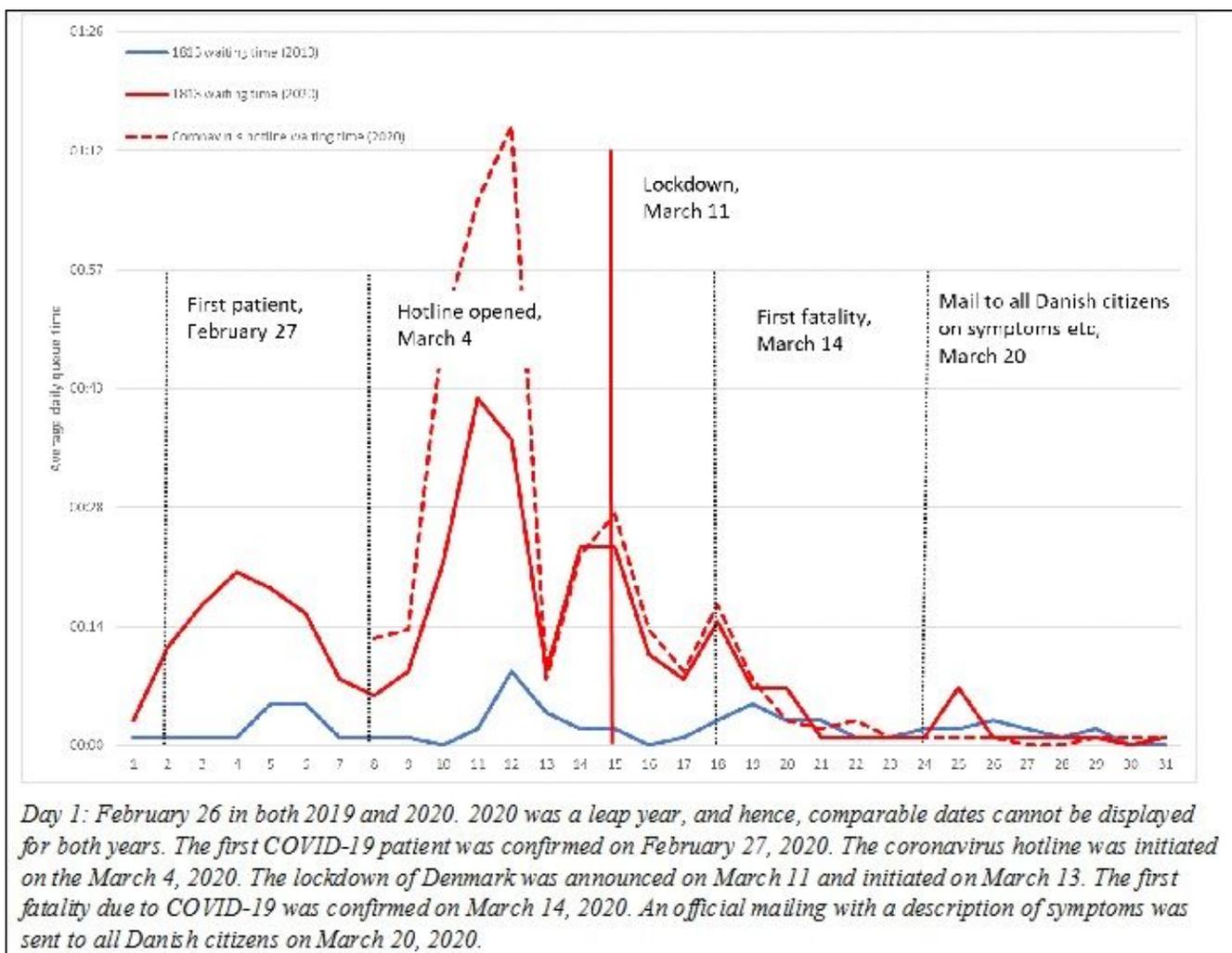


Figure 4

Queues for EMS lines and key events around the Danish COVID-19 impact