Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Z. Evid. Fortbild. Qual. Gesundh. wesen (ZEFQ) 165 (2021) 35–42

Contents lists available at ScienceDirect

Z. Evid. Fortbild. Qual. Gesundh. wesen (ZEFQ)

journal homepage: http://www.elsevier.com/locate/zefq

Management der Gesundheitsversorgung / Health Care Management

Experiences made by family physicians managing patients with SARS-CoV-2 infection during spring 2020 – a cross-sectional analysis

*Erfahrungen von Hausärzt*innen mit der Versorgung von Patient*innen mit SARS-CoV-2-Infektion im Frühjahr 2020 – eine Querschnittuntersuchung*

Christoph Strumann[a,*], Wolfgang C.G. von Meißner[b], Paul-Georg Blickle[b], Linda Held[a], Jost Steinhäuser[a]

[a] *Institute of Family Medicine, University Medical Center Schleswig-Holstein, Campus, Lübeck, Germany*
[b] *Hausärzte am Spritzenhaus, Family Practice, Baiersbronn, Germany*

ARTICLE INFO

Article History:
Received: 3 November 2020
Received in revised form: 31 May 2021
Accepted: 16 July 2021
Available online: 30 August 2021

Keywords:
SARS-CoV-2
COVID-19
General practice
Family medicine
Primary care
Germany
Rural and urban areas

ABSTRACT

Background: In Germany, family physicians care for about 85% of the patients infected with SARS-CoV-2. The geographic distribution of the first wave in 2020 was heterogeneous, and each federal state experienced different percentages of patients that died from COVID-19. Each of the 16 federal states implemented its own regulation about medical care for SARS-CoV-2 infected patients. Against this background, the objective of this analysis was to gather experiences made by primary care physicians managing SARS-CoV-2 infected patients during the first wave in March 2020 and to clinically characterize these patients.
Methods: In total, 5,632 physicians were invited to participate in an online questionnaire surveying routine data regarding the general care situation at the physician practice level and the care for patients infected with SARS-CoV-2. Bivariate and multivariate analyses were applied to characterize treatment experiences and to identify patient characteristics predicting the course of disease.
Results: 132 family physicians from all German federal states (except from Berlin) participated in this analysis (response rate 2.3%) and provided routine care data for 1,085 patients. Information from 373 of these patients were provided in greater detail. On average, each physician treated 8.5 patients infected with SARS-CoV-2. About 15% of the physicians used video consultations to communicate with their infected patients. More than 82% made positive experiences with the exceptional regulation to provide a certificate of incapacity to work by telephone. Half of the physicians faced equipment insufficiencies due to a lack of protective gear, and in 10% of the practices, the staff themselves acquired SARS-CoV-2 infection. Greater numbers of SARS-CoV-2 cases treated in a practice translated into higher odds for members of the practice to get infected (odds ratio (OR) 1.03, 95% CI [1.01;1.06]). Older persons, males and patients in rural areas had higher odds of a severe course of disease.
Conclusions: Our results show that a large percentage of primary care physicians additionally managed their COVID-19 patients remotely by telephone or video during the outbreak, while also being at a higher risk for SARS-CoV-2 infection. Further, the increased severity in rural areas underlines the importance of strong primary health care in order to enable hospitals to concentrate on critically ill patients.

ARTIKEL INFO

Artikel-Historie:
Eingegangen: 3. November 2020
Revision eingegangen: 31. Mai 2021
Akzeptiert: 16. Juli 2021
Online gestellt: 30. August 2021

Schlüsselwörter:
SARS-CoV-2
COVID-19

ZUSAMMENFASSUNG

Hintergrund: In Deutschland betreuen Hausärzt*innen etwa 85% der mit SARS-CoV-2 infizierten Patient*innen. Die geografische Verteilung der ersten Infektionswelle im Frühjahr 2020 war heterogen und auch die relative Anzahl an Todesfällen variierte stark je nach Bundesland. Jedes der 16 Bundesländer hat seine eigenen Regelungen zur Versorgung von Patient*innen mit einer SARS-CoV-2-Infektion erlassen. Vor diesem Hintergrund war das Ziel dieser Analyse, Erfahrungen von Hausärzten in der Behandlung von SARS-CoV-2 infizierten Patient*innen während der ersten Welle im März 2020 zu erheben und diese Patient*innen klinisch zu charakterisieren.

* Korrespondenzadresse. Dr. Christoph Strumann, University Hospital Schleswig-Holstein, Campus Luebeck, Institute of Family Medicine, Ratzeburger Allee 160, 23538 Luebeck, Germany.
E-mail: c.strumann@uni-luebeck.de (C. Strumann).

https://doi.org/10.1016/j.zefq.2021.07.005
1865-9217/

Allgemeinmedizin
Familienmedizin
Primärversorgung
Deutschland

Methoden: Insgesamt wurden 5.632 Ärzt*innen eingeladen, an einem Online-Fragebogen teilzunehmen, in dem Routinedaten zur allgemeinen Versorgungssituation in der Arztpraxis und zur Versorgung von mit SARS-CoV-2 infizierten Patient*innen erhoben wurden. Bivariate und multivariate Analysen wurden angewendet, um die Erfahrungen zu charakterisieren und Patientenmerkmale zu identifizieren, die den Krankheitsverlauf vorhersagen.
Ergebnisse: Aus allen Bundesländern (außer aus Berlin) nahmen 132 Hausärzt*innen teil (Rücklaufquote: 2.3%) und stellten ihre Routinedaten zur Behandlung von 1.085 Patient*innen zur Verfügung, wobei für 373 Patient*innen detaillierte Informationen bereitgestellt wurden. Im Durchschnitt behandelte jede*r Ärzt*in 8,5 Patient*innen mit einer SARS-CoV-2 Infektion. Etwa 15% der Ärzt*innen nutzten Videokonsultationen für die Kommunikation mit ihren COVID-19 Patient*innen. Mehr als 82% haben positive Erfahrungen mit der Ausnahmeregelung gemacht, die es ermöglichte, eine Arbeitsunfähigkeitsbescheinigung per Telefon auszustellen. Die Hälfte der Ärzt*innen hatte Probleme mit unzureichender Schutzausrüstung und 10% der Ärzt*innen waren von einer SARS-CoV-2-Infektion innerhalb ihres Praxispersonals betroffen. Die Anzahl der behandelten SARS-CoV-2-Fälle erhöhte das Infektionsrisiko für das Praxispersonal (Odds Ratio (OR): 1,03; 95%-CI [1.01;1.06]). Ältere, Männer und Patient*innen in ländlichen Gebieten hatten ein höheres Risiko für einen schweren Krankheitsverlauf.
Schlussfolgerung: Unsere Ergebnisse zeigen, dass ein großer Teil der Hausärzt*innen ihre COVID-19 Patient*innen während des Ausbruchs im März 2020 zusätzlich aus der Ferne mit Telefon oder Video betreuten und gleichzeitig ein höheres Risiko für eine SARS-CoV-2-Infektion hatten. Darüber hinaus untermauert das höhere Risiko für einen schweren Krankheitsverlauf in ländlichen Gebieten die Notwendigkeit einer starken hausärztlichen Versorgung, damit sich Krankenhäuser weiterhin auf schwererkrankte Patient*innen konzentrieren können.

Introduction

By the end of January 2020, the first case of confirmed SARS-CoV-2 infection has been detected in Germany [1]. At the beginning of March 2020, the dynamic of the first infection wave picked up until its containment in mid-June 2020. During this first wave, there have been more than 190,000 cases of confirmed SARS-CoV-2 infections and more than 8,600 deaths due to Coronavirus Disease 2019 (COVID-19) [2]. According to national guidelines these patients were primarily quarantined at home [3]. Therefore, about 85% of the patients infected with SARS-CoV-2 were cared for mostly by family physicians in community practices which allowed hospitals to concentrate on critically ill patients [4].

In Germany, the geographic distribution of this first wave was heterogeneous. While Bavaria, Baden-Württemberg and Hamburg have faced the highest infection rates, the infections in the other federal states have been substantially lower [4]. Also, the percentage of patients that died until summer 2020 due to COVID-19 from all known German SARS-CoV-2 infected patients ranged from 0.8% to 2.9% across the federal states [5]. Each of the 16 federal states made its own regulation about the care for patients with SARS-CoV-2 infection after the early outbreak in March 2020. In general, regional Associations of Statutory Health Insurance Physicians (ASHIPs) offered a hotline service and set up drive-in test-centers (see Appendix A, Supplement 1 for more details). While there are several studies with regards to the situation of hospitals under the pandemic for Germany [6,7], as well as studies that describe the clinical characteristics for hospitalized COVID-19 patients [8–10], research about the primary care situation is under-represented.

In this analysis, we gathered experiences of family physicians managing SARS-CoV-2 infected patients during the first outbreak in March 2020 and clinically characterized their patients.

Methods

Questionnaire and data collection

This cross-sectional analysis was performed online between April 24th and 28th May 2020 using Surveymonkey©. Three different emailing lists were used to reach the 5,632 members of the German College of General Practitioners and Family Physicians (DEGAM) [11]. The rationale for the questionnaire was to gather data describing the routine care of COVID-19 patients by primary care physicians in Germany during the first outbreak of SARS-CoV-2 in spring 2020. The development of the questionnaire was based on the SARS-CoV-2 guideline recommendations of the DEGAM [3] as well as treatment experiences with SARS-CoV-2 management of three of the authors who are family physicians. The questionnaire was not formally validated but piloted for clearness and understandability. It included 15 items about the general care situation at the physician practice level and 12 items considering the care of each infected patient (see Appendix A, Supplement 2 for more details). The physicians were asked to extract the latter information from their routine data or documentations. The collected anonymous data are stored in a protected data server at the Institute of Family Medicine in Luebeck, Germany.

To characterize the primary care situation in Germany while also taking into account the heterogeneous occurrence of infections across the federal states, we tabulated the physician specific variables for regions with low and large outbreaks of SARS-CoV-2 infections. We defined the federal states Bavaria, Baden-Württemberg and Hamburg as regions with a large outbreak, since they have faced the highest number of all registered infections per thousand inhabitants (>100) during the first wave [4].

Statistical analysis

Differences between the subgroups were tested for statistical significance by either employing the Pearson χ^2-test, the Mann-Whitney U-test or the nonparametric test for trends across ordered groups [12], depending on the scale of the considered variable. Structural differences between physicians with an infected employee are identified by a multivariate logistic regression analysis.

The patients' clinical characterization was made by considering differences between mild and severe courses of diseases, i.e. if the patient died or was admitted to the hospital due to the SARS-CoV-2 infection [13]. The considered variables characterized the patients' demography, underlying medical conditions, symptoms, diagnostic and treatment. A multivariate logistic regression analysis of the course of disease was applied to identify risk factors and predictive symptoms. Statistical analyses were performed with STATA 15 (StataCorp LLC, College Station, TX, USA).

Ethics

The analysis of these routine care data was approved by the ethics committee of Luebeck University on April 24th 2020 (number of approval: 20-124A).

Results

Physician characteristics

132 family physicians from all federal states of Germany (except Berlin) participated in this survey (response rate: 2.3%). The most physicians (n = 77) had a practice located in a region with a large outbreak, 7 participants did not provide information about the location of their practice (see Appendix A, Supplement 1 for more details about the distribution across the federal states). 6.1% of the participants were above 65 years old, 40.2% were female and 54.3% worked in a rural area (see Table 1).

The average number of SARS-CoV-2 cases was 8.5 and significantly higher in regions with a large outbreak (11.9 (high) vs. 6.7 (low), p=0.013). Altogether, the participating physicians cared for 1,085 SARS-CoV-2 infected patients. Most of the physicians (64.6%) spent less than 30 minutes per day on caring for infected patients, but 44.2% spent more than 2 hours on addressing questions regarding SARS-CoV-2. In regions with a large outbreak, the percentages of physicians spending more than 30 minutes per day on both (caring and consulting) were larger in comparison with regions with a low outbreak. The distributions of the percentages were significantly different between both regions. About 9% had a SARS-CoV-2 infection within their practice staff (12.8%/5.3% in regions with a large/low outbreak, p=0.139). Sufficient protective gear was available for 49% of the participants.

The majority of physicians were in contact with their COVID-19 patients via telephone (88.6%) and 15% used video consultations. Physical contact by practice consultations were reported by 25% of the physicians and nearly 20% reported home visits. The experiences regarding the temporary possibility to provide a certificate of incapacity to work by telephone were rated as good or very good by 91 (82%) of the physicians.

Four multivariate regression models were estimated to explain variations in the probability of a SARS-CoV-2 infection of the practice staff (see Table 2). Due to the small physician sample size, only a few variables were included. In Model (1), the assessment whether the physicians had had sufficient protective gear during the first wave was solely considered. In Model (2) and (3), the model was extended by other variables with the highest contribution to the model fit. In Model (4), the region type was additionally controlled for. The results revealed that higher numbers of SARS-Cov-2 cases that have been treated in the practice were associated with higher odds for an infection of the practice staff (odds ratio (OR): 1.03, 95%CI:(1.01;1.06)). The odds of having an infected employee for physicians who lacked sufficient protective gear were about 4 (≈1/0.24) times higher than those who were equipped with sufficient protective gear. However, in the final model, the latter result is only significant at the 10% level (OR: 0.24, 90%CI:(0.06;0.92)). A good communication with municipality (OR: 1.99, 95%CI:(1.11;3.56)) was also found to be associated with increased odds for an infection of an employee. A significant difference in infection rates between rural and urban regions was not detected.

Patient characteristics

In total, 116 physicians provided more details about their patients. Detailed data about 374 (34%) patients were available (see Table 3). On average, the patients were 50.8 years old, 45.3% were female and 68.2% visited a practice located in a rural area. The most common risk factor for all patients infected with SARS-CoV-2 was hypertension (28.6%), followed by diabetes mellitus, smoking, weakened immune system, asthma, obesity, malignancy and chronic obstructive pulmonary disease (COPD). The most common presenting symptoms were cough (68.2%), fatigue, fever and body aches.

The percentage of patients struggling with a severe course of disease was 10.7%. Males and elderly were more likely to be observed in this group (OR: 2.1 (male, 95%CI:(1.05;4.16)) and 1.1 (age, 95%CI:(1.06;1.12))). COPD had the highest association with a severe course of disease (OR: 12.2, 95%CI:(2.54;54.67)), followed by diabetes mellitus and hypertension. Furthermore, shortness of breath in rest was associated with a severe course of disease (OR: 5.9, 95%CI:(2.94;13.43)). Meanwhile, headache, sore throat, loss of smell/taste and rhinorrhea were more often observed in patients with a mild course.

Four multivariate logistic regression models were estimated, starting with a parsimonious specification that gradually incorporated more complexity aiming to investigate potential sensibility of the results (see Table 4). In Model (1), only demographic characteristics were included. The fit of the models substantially improved after adding variables representing underlying medical conditions (2) or symptoms (3). In Model (4), all variables were included obtaining the highest fit. Except for sore throat, all estimates remained the same direction over the different model specifications. Due to the large percentage of missing observations, we excluded the variable obesity from the list of the underlying medical conditions. The variable asymptomatic was not considered in the regression analysis, because of its collinearity with the other variables representing symptoms. Multicollinearity seemed not to be an issue, since the Variation Inflation Factors (VIFs) were all below 2, with an exception for the physician's number of treated SARS-CoV-2 cases (VIF = 2.4).

In total, we had valid data for 310 patients for the final model specification (4). Similar to the bivariate analysis, males and older people faced higher odds of having a severe course of disease. The odds for patients visiting a primary care practice in a rural region were about 5 times higher for having a severe course of disease than for patients in urban regions (OR: 5.5, 95%CI:(4.86;6.25)). COPD and asthma had the highest odds ratios (OR: 13.7, 95%CI:(12.02;15.97) and 12.8, 95%CI:(12.31;13.36), respectively). Patients with diabetes, a weakened immune system and other chronical diseases were also found to have higher odds. Shortness of breath in rest, diarrhea, fever, body ache and shortness of breath under stress were also associated with a severe course of disease.

Discussion

In this analysis, we reported experiences of family physicians managing infected patients during the first wave in March 2020 and clinically characterized their infected patients.

Physicians

The geographic distribution of the first wave of SARS-CoV-2 infections in March 2020 was heterogeneous in Germany. Bavaria, Baden-Württemberg and North Rhine-Westphalia have faced 65% of all registered infections [4], while having 51% of the population [14]. In this analysis, the percentage of patients treated by physicians from these federal states is very similar, i.e. 66%. Even if the total time spent for the treatment of patients with SARS-CoV-2 infections is lower in the regions with a low outbreak, a large percentage of primary care physicians spent more than 2 hours daily addressing questions of patients regarding SARS-CoV-2 (35.6%/59.2% in regions with a low/large outbreak). At the beginning of the pandemic, in Germany, the reimbursement was not adapted accordingly to take into account the higher resource use. This has led to a situation with similar workloads and a reduced reimbursement due to fewer visits by patients with other complaints than SARS-CoV-2 [15].

Moreover, primary care physicians had an increased risk of being infected, because they lacked sufficient protective gear. Our results show that every second physician states to have had insufficient personal protective equipment during March 2020 and that

Table 1
Characteristics of physicians, by region with low and high outbreaks.

	All n = 132		regions with low outbreaks n = 77		large outbreaks n = 48		
Characteristic	*n* =	%	*n* =	%	*n* =	%	p-value
percentage of physicians that are							
female	132	40.2	77	35.1	48	54.2	0.036
male	132	59.8	77	64.9	48	45.8	0.036
aged under 40	132	12.1	77	15.6	48	8.3	0.054[b]
aged between 40 and 65	132	81.8	77	81.8	48	81.3	
aged above 65	132	6.1	77	2.6	48	10.4	
located in an urban region	127	45.7	76	43.4	44	50.0	0.486
located in a rural region	127	54.3	76	56.6	44	50.0	0.486
number of treated SARS-CoV-2 cases							
mean	127	8.5	76	6.7	46	11.9	0.013[a]
std	17.8		17.8		18.8		
total	1085		496		546		
time needed per day for treating SARS-CoV-2 patients (percentage of physicians)							
no time yet	130	10.0	75	10.7	48	8.3	0.003[b]
< 30 min	130	54.6	75	61.3	48	47.9	
30min - 2 h	130	26.2	75	28.0	48	18.8	
>2h	130	9.2	75	0.0	48	25.0	
time needed per day for advising patients about a SARS-CoV-2 infection (percentage of physicians)							
no time yet	129	0.0	74	0.0	48	0.0	0.014[b]
< 30 min	129	14.7	74	18.9	48	8.3	
30min - 2 h	129	41.1	74	44.6	48	33.3	
>2h	129	44.2	74	36.5	48	58.3	
percentage of physicians that had contact to SARS-CoV-2 patients							
via telephone	132	88.6	77	85.7	48	93.8	0.166
via video	132	15.2	77	15.6	48	12.5	0.632
home visit	132	19.7	77	15.6	48	29.2	0.069
practice consultation	132	25.0	77	20.8	48	29.2	0.286
others	132	13.6	77	9.1	48	20.8	0.063
sickness certification by telephone							
number (mean)	119	87.7	69	82.8	44	101.1	0.303[a]
percentage of physicians assessing the experience as							
good	129	82.2	75	84.0	47	80.9	0.521[b]
neutral	129	10.1	75	9.3	47	8.5	
bad	129	7.8	75	6.7	47	10.6	
Assessment of the communication with the following institutions regarding SARS-CoV-2 (5: very good, . . ., 1: very bad)							
mean							
Association of Statutory Health Insurance Physicians	125	3.3	74	3.3	44	3.3	0.984[a]
local health authority	124	2.8	70	2.7	47	2.9	0.330[a]
Municipality	101	2.8	56	2.8	41	2.8	0.979[a]
percentage of physicians with							
sufficient protective clothing	130	49.2	76	51.3	47	44.7	0.474
infected employees	130	9.2	76	5.3	47	12.8	0.139
number of patients with a SARS-CoV-2 infection for whom routine data were made available included in this study *(mean)*	132	2.8	77	1.5	48	5.1	0.003[a]

[a] Mann–Whitney U-test P value.
[b] Nonparametric test for trend across ordered groups [12].

Table 2
Multivariate regression results, infected employees (odds-ratios).

Characteristic	(1)	(2)	(3)	(4)
sufficient protective gear	0.31*	0.32	0.21**	0.24*
number of treated SARS-CoV-2 cases		1.03*	1.03**	1.03**
communication with municipality			1.85**	1.99**
rural				0.29
Observations	130	127	121	116
R^2-McFadden (in %)	4.1	8.6	15.3	20.2
Log-likelihood value	-38.4	-34.1	-31.2	-29.0
Akaike information criterion (AIC)	80.8	74.2	70.5	68.1
Bayesian information criterion (BIC)	86.5	82.7	81.7	81.8

Note: Estimated by means of Maximum Likelihood. Observations with missing data points were not considered. Significance levels: * p< 10%, ** p< 5%, *** p< 1%.

Table 3
Characteristics of SARS-CoV-2 infected patients, by course of disease status.

Characteristic	all n = 374		course of disease: mild n(%) = 334(89.3)		severe n(%) = 40(10.7)		Odds ratio[a]	p-value
	n =	%	*n* =	%	*n* =	%		
Demographics								
female	371	45.3	331	47.1	40	30.0	0.48	0.043
male	371	54.4	331	52.6	40	70.0	2.11	0.040
age								
mean	365	50.8	325	48.6	40	68.9	1.09	< 0.001
(min-max)	(11-93)	(11-87)	(37-93)					
urban	352	31.8	303	32.7	33	18.2	0.46	0.095
rural	352	68.2	303	67.3	33	81.8	2.18	0.095
region with outbreak								
large	341	61.6	297	65.0	29	51.7	0.58	0.160
low	341	38.4	297	35.0	29	48.3	1.73	0.160
Underlying medical conditions								
hypertension	371	28.6	331	25.4	40	55.0	3.59	< 0.001
other chronical diseases	371	19.1	331	17.2	40	35.0	2.59	0.009
diabetes mellitus	373	8.8	333	6.9	40	25.0	4.49	< 0.001
smoking	373	6.7	333	6.9	40	5.0	0.71	0.650
weakened immune system	369	4.9	329	4.6	40	7.5	1.70	0.420
asthma	373	4.8	333	4.2	40	10.0	2.53	0.118
obesity	278	3.6	238	3.8	40	2.5	0.65	0.689
malignancy	371	3.0	331	2.7	40	5.0	1.88	0.429
chronic obstructive pulmonary disease	371	1.9	331	0.9	40	10.0	12.15	0.001
Symptoms								
cough	371	68.2	331	68.6	40	65.0	0.85	0.646
fatigue	371	64.4	331	65.3	40	57.5	0.72	0.335
fever	371	56.3	331	54.7	40	70.0	1.93	0.069
body aches	371	47.2	331	48.3	40	37.5	0.64	0.197
sudden onset of illness	371	43.4	331	42.6	40	50.0	1.35	0.374
headache	371	41.5	331	44.4	40	17.5	0.27	0.002
sore throat	371	41.2	331	43.2	40	25.0	0.44	0.031
loss of smell/taste	373	35.4	333	38.1	40	12.5	0.23	0.003
rhinorrhea	371	29.1	331	32.0	40	5.0	0.11	0.003
shortness of breath under stress	371	19.9	331	18.7	40	30.0	1.86	0.096
chest pressure	371	16.2	331	16.6	40	12.5	0.72	0.506
diarrhea	371	14.8	331	14.5	40	17.5	1.25	0.615
shortness of breath in rest	371	10.2	331	7.6	40	32.5	5.89	< 0.001
other symptoms	369	10.0	329	9.4	40	15.0	1.70	0.272
asymptomatic	359	3.6	319	4.1	40	0.0	1.00	-
days since first symptoms appear (*mean*)	341	3.5	305	3.5	36	3.7	1.03	0.709
Diagnostic								
PCR test confirmation	366	95.6	328	95.4	38	97.4	-	1.000[b]
IgA antibody-positivity	111	59.5	108	58.3	3	100.0	-	0.270[b]
IgG antibody-positivity	117	40.2	114	38.6	3	100.0	-	0.062[b]
IgM antibody-positivity	9	44.4	8	37.5	1	100.0	-	0.444[b]
chest X-ray	372	15.3	333	8.7	39	71.8	-	< 0.001[b]
diagnosed infiltrates	136	26.5	104	12.5	32	71.9	-	< 0.001[b]
course of the disease								
still under monitoring	374	12.3	334	12.6	40	10.0	-	0.802[b]
hospital (normal ward)	374	5.3	334	0.0	40	50.0	-	< 0.001[b]
hospital (intensive care unit)	374	4.0	334	0.0	40	37.5	-	< 0.001[b]
hospital (invasive ventilation)	374	2.1	334	0.0	40	20.0	-	< 0.001[b]
death	374	3.2	334	0.0	40	30.0	-	< 0.001[b]
unknown	374	0.0	334	0.0	40	0.0	-	< 0.001[b]
healthy at end of quarantine	374	81.6	334	86.5	40	40.0	-	< 0.001[b]
others	374	2.9	334	2.1	40	10.0	-	0.021[b]
treatment								
symptomatic	278	79.1	238	86.6	40	35.0	-	< 0.001[b]
Antibiotics: amoxicillin/ clavulanic acid	278	34.2	238	27.3	40	75.0	-	0.001[b]
Antibiotics: azithromycin	278	3.6	238	3.8	40	2.5	-	1.000[b]
Antibiotics: other	278	7.9	238	5.9	40	20.0	-	0.006[b]
referral to hospital	374	14.2	334	5.7	40	85.0	-	< 0.001[b]
others	278	10.1	238	10.5	40	7.5	-	0.778[b]

If not otherwise indicated, the p-values are based on the Pearson χ^2-test.
[a] Odds ratio of having a severe course of disease.
[b] Fisher's exact test p-value.

Table 4
Multivariate regression results of a severe course of disease for SARS-CoV-2 infected patients (odds-ratios).

Characteristic	(1)	(2)	(3)	(4)
Socio-Demo-Geographics				
female	0.40***	0.42***	0.47***	0.54***
age	1.08***	1.08***	1.08***	1.09***
rural	2.95***	6.24***	2.58***	5.51***
physician's number of treated SARS-CoV-2 cases	0.97*	0.97*	0.98<	0.98<
Underlying medical conditions				
hypertension		0.59***		0.60***
other chronical diseases		1.84***		1.25***
diabetes mellitus		2.38***		2.82***
smoking		0.28***		0.31***
weakened immune system		1.59***		2.10***
asthma		10.00***		12.82***
malignancy		0.20***		0.16***
chronic obstructive pulmonary disease		21.10***		13.86***
Symptoms				
cough			0.68***	0.72***
fatigue			0.56***	0.59***
fever			3.14***	3.41***
body aches			2.03***	2.79***
sudden onset of illness			0.88***	0.88**
headache			0.55***	0.42***
sore throat			0.90***	1.17***
loss of smell/taste			0.47***	0.69***
rhinorrhea			0.54***	0.55***
shortness of breath under stress			2.17***	2.06***
chest pressure			0.64***	0.49***
diarrhea			4.21***	3.97***
shortness of breath in rest			9.49***	7.65***
other symptoms			0.91<	1.36***
Observations	310	310	310	310
McFadden R^2 (in %)	28.8	35.3	42.2	47.0
Log-likelihood value	-71.7	-65.2	-58.2	-53.5
Akaike information criterion (AIC)	145.4	132.5	118.4	108.9
Bayesian information criterion (BIC)	149.2	136.2	122.2	112.6

Note: Estimated by means of Maximum Likelihood. To take into account an imbalance of the physicians providing patient data, standard errors are clustered for two physicians that provided data about 96 and 38 patients, respectively, and the others. Observations with missing data points were not considered. Significance levels:
* p< 10%
** p< 5%
*** p< 1%

it is correlated with a higher risk of having an infected employee. In regions with a large outbreak, nearly 15% of the surveyed physicians have had an infected employee, while the cumulative incidence rate of the underlying population was 0.3% until June 2020 [4,16]. In several countries, health care workers are facing a substantial higher rate of infection than the general population [17,18]. The protection of health care workers is crucial in containing the outbreak, as it negates an important source for spreading the virus to their patients [19] and ensures a continuous care for patients. Primary care physicians play a significant role by building an easy access to the health system [20]. They help people to cope with their anxiety about SARS-CoV-2 and ensure patients keep seeking out consultations for other underlying diseases as well. This would lead for patients to not ignore other health problems they might have, and prevent an aggravation of their situation, as they otherwise might focus solely on SARS-CoV-2 to their detriment. Moreover, primary care physicians make early diagnoses and differentiate the critically ill patients from those with a mild course of disease and, thus, help to reduce the demand for hospital services and allow hospitals to concentrate on patients with severe courses [21,22]. The relatively high proportion of SARS-CoV-2 infected patients that are cared for in outpatient practices (85%) [4] is considered to be one of the reasons as to why Germany managed the first wave of the pandemic situation relatively well [23].

In Germany, physicians have been temporarily allowed to provide a certificate of incapacity by telephone in case of upper respiratory tract infections in order to reduce the risk of spreading the virus by physical contact between patients and their physicians. In this analysis, almost all physicians used this option and evaluated their experience positively, advocating for its continuation. Due to the increase of infections in fall 2020, the certificate of incapacity by telephone has been reinstated [24].

Most physicians relied on remote technologies. Especially video consultations were used far more often than in the past [25,26]. For mild and moderately severe courses of the disease, the combination of "long term knowing the patient" (which is characteristic in primary care) and telemedicine based assessment might be promising tools for the future [27,28]. However, regarding the care of older patients that are frail or have multiple chronic conditions and are additionally suffering from social distancing measures, remote care quickly reaches its limits and in-person visits are essential for preventing patients from refraining to consult their doctors [29]. In this analysis, every fourth physician consulted their infected patients in their practice. If the practice visit is considered as too challenging, home visits might be an alternative, which was done by about 20% of the physicians. To support the primary care physicians in order to make them able to fulfill their crucial role of containing the pandemic crisis and simultaneously guarantee a continuous care provision, it is essential to equip them with enough protective gear. In Germany, the authorities have made coordinated efforts to equip practices with sufficient protective gear. However, the situation remains heterogeneous across the distinct states [30,31].

Patients

With 1,085 patients cared by the participants, we obtained an insight into about 2% of the SARS-CoV-2 infected patients that were diagnosed until end of March 2020 [32]. Nearly 11% of the reported patients had a severe course of the disease, i.e. hospitalization. This number is smaller than the national percentage of 17% hospitalized patients in Germany [32]. This difference underlines the well-functioning separation of care, as primary care concentrates mostly on the treatment of the mild cases, while hospitals treat the critically ill patients, some of which enter the hospital directly.

Similar to related studies, older patients and males have a higher risk for a severe course of disease [13,33,34]. Similar gender differences in the risk for a severe course of disease have also been observed in the SARS outbreak in 2003 [35]. Jordan et al. [33] suggest that the higher risks for men in Italy could be partly explained by their higher smoking rates and subsequent comorbidities. In related studies as well as in our own, the gender differences were robust after controlling for respective variables. Jin et al. [35] argue that the higher circulating ACE2 receptor levels for men could be responsible for this difference. Nonetheless, primary care physicians should take into account the gender in addition to the age of their patients for the determination of the risk for a severe course of disease.

Our results suggest that the odds for hospitalization of patients located in rural areas are more than twice as large as for patients in urban areas. Some studies obtain a similar finding for the US and argue that US rural areas are (similar to Germany) characterized by an older population with lower incomes facing more underlying health conditions and greater travel distances [36–38]. In Germany, rural areas are particularly affected by a declining number of GPs, resulting in local shortages [39,40]. One might also consider a selection effect while interpreting this result; patients in rural areas with a suspected infection might be more likely to consult a primary care practice instead of a hospital, e.g. because of greater travel distances. Regardless of which interpretation is closer to the truth, both suggest that a strong primary care is crucial, especially in rural areas, for addressing the health burden of the pandemic.

The estimated associations of underlying medical conditions and the hospitalization risk are similar to related studies [13,33,34]. We also identify hypertension, diabetes mellitus, asthma and COPD as well as other chronical diseases as predictors. Malignancy and a weakened immune system are also positively associated with a severe course of the disease. Most findings are confirmed in the multivariate analysis (Table 4). Most of the reported symptoms and its occurrences are similar to the symptoms observed by the Robert-Koch-Institute for Germany [4] and related international studies [41,42]. While body aches, fever, sudden onset of illness, breathlessness and diarrhea are found to be positively associated with critical illness, the opposite occurs for cough, fatigue, headache, sore throat, loss of smell/taste, rhinorrhea, chest pressure and asymptomatic occurrences. However, the latter results should be interpreted very carefully. It cannot be ruled out that patients facing a mild course of disease are reporting rather mild symptoms (e.g. cough, fatigue, headache, rhinorrhea) if they are asked for the reasons for the clinical suspicion for the infection. In contrast, patients suffering from critical illness might concentrate their attention solely on the most harmful symptoms (e.g. fever, diarrhea, breathlessness) while neglecting the mild ones.

Strengths and limitations

A strength of this analysis is that it relies on the reporting of primary care physicians from almost all federal states located in rural and urban areas. The only exception was Berlin, as no physician from Berlin had answered our questionnaire. Nonetheless, this allows a comprehensive assessment of the experiences of physicians managing SARS-CoV-2 infected patients in Germany. However, the representativeness of the findings could be impaired by a selection bias or response bias due to the small sample size of surveyed physicians (n = 132) because of the low response rate (2.3%) and the distribution of the respondents across the federal states [43]. In general, a low response rate of primary care physicians in research projects is also observed in other practice-based studies and is considered as a potential source of bias [44]. The reported data of the selected patients might also be influenced by a selection bias. The surveyed physicians might have remembered or have found it more important to report the critical cases. Therefore, the percentage of hospitalized primary care patients (i.e., 10%) should be considered as rather overestimated.

The age of the sampled physicians is lower than the nationwide age. While 12% of the physicians in our sample are under 40 years old, the respective nationwide percentage is 7%. Physicians aged between 40 and 65 are only slightly overrepresented in our analysis (82% vs. 79%). The percentage of female physicians is somewhat smaller than the respective nationwide percentage of women in primary care (40% vs. 47%) [45].

The cross-sectional data only allows to analyze associations between the considered variables that cannot be interpreted as causal relationships. For instance, the positive association between good communication with municipality and infection risk might be explained by experiencing a good support from the local health authority after the occurrence of the employee's infection. The findings that hypertension, malignancy and smoking could prevent hospitalization might be artifacts due to high correlation between the considered variables or disproportionately missing values [13].

Conclusion

In this analysis, we report on the treatment experiences of German family physicians during the first outbreak of SARS-CoV-2 infections in March 2020 and clinically characterize their infected patients. We provide first insights into the German primary care situation under the pandemic, which have been under-represented, since most research has focused on hospitals. Our results show that a large percentage of physicians were not equipped with sufficient protective gear, which increased their risk for a SARS-CoV-2 infection. They also managed their patients remotely by telephone or video during the outbreak. Moreover, a higher probability for having a severe course was observed in rural areas underlining the need for a strong primary care to enable hospitals to concentrate on critically ill patients.

Funding

No external funding was used for this analysis.

Acknowledgment

We thank Josef Pömsl and Thomas Kötter for piloting the questionnaire. Further, we thank Hans-Otto Wagner and Michael Kochen for the support to distribute the link of the online questionnaire.

Conflict of interest

The authors declare that they have no conflicts of interest.

CRediT author statement

Christoph Strumann: Conceptualization, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. Wolfgang C. G von Meißner: Conceptualization, Methodology, Writing-Reviewing and Editing. Paul-Georg Blickle: Conceptualization, Methodology, Writing-Reviewing and Editing. Linda Held: Data Collection, Writing-Reviewing and Editing. Jost

Steinhäuser: Conceptualization, Investigation, Validation, Writing – review & editing.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi: doi:10.1016/j.zefq.2021.07.005.

References

[1] Lebensmittelsicherheit BLfGu, Robert Koch-Institut:. Beschreibung des bisherigen Ausbruchsgeschehens mit dem neuartigen Coronavirus SARS-CoV-2 in Deutschland (Stand: 12. Februar 2020). Epidemiologisches Bulletin 2020;2020(7):3–4.

[2] Schilling J, Lehfeld A-S, Schumacher D, Diercke M, Buda S, Haas W, Group RC-S:. Disease severity of the first COVID-19 wave in Germany using reporting data from the national notification system. In.: Robert Koch-Institut; 2021:1–19.

[3] Deutsche Gesellschaft für Allgemeinmedizin und Familienmedizin: Neues Coronavirus (SARS-CoV-2) - Informationen für die hausärztliche Praxis. DEGAM S1-Handlungsempfehlung. https://www.degam.de/files/Inhalte/Leitlinien-Inhalte/Dokumente/DEGAM-S1-Handlungsempfehlung/053-054%20SARS-CoV-2%20und%20Covid-19/Publikationsdokumente/Publikationsdokumente_Version%2016/053-054L_Neues%20Coronavirus_21-12-2020.pdf.(Accessed on January 31, 2021).

[4] Robert Koch Institut: Coronavirus Disease 2019 - Daily Situation Report. https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte/2020-06-29-en.pdf?__blob=publicationFile.(Accessed 30 June 2020).

[5] Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. The Lancet Infectious Diseases 2020;20(5):533–4.

[6] Haffer H, Schömig F, Rickert M, Randau T, Raschke M, Wirtz D, Pumberger M, Perka C. Impact of the COVID-19 Pandemic on Orthopaedic and Trauma Surgery in University Hospitals in Germany: Results of a Nationwide Survey. JBJS 2020;102(14.).

[7] Hentschker C, Mostert C, Klauber J, Malzahn J, Scheller-Kreinsen D, Schillinger G, Karagiannidis C, Busse R. Stationäre und intensivmedizinische Versorgungsstrukturen von COVID-19-Patienten bis Juli 2020. Medizinische Klinik - Intensivmedizin und Notfallmedizin 2021.

[8] Karagiannidis C, Mostert C, Hentschker C, Voshaar T, Malzahn J, Schillinger G, Klauber J, Janssens U, Marx G, Weber-Carstens S, et al. Case characteristics, resource use, and outcomes of 10021 patients with COVID-19 admitted to 920 German hospitals: an observational study. The Lancet Respiratory Medicine 2020;8(9):853–62.

[9] Dreher M, Kersten A, Bickenbach J, Balfanz P, Hartmann B, Cornelissen C, Daher A, Stöhr R, Kleines M, Lemmen SW, et al. The Characteristics of 50 Hospitalized COVID-19 Patients With and Without ARDS. Dtsch Arztebl Int 2020;117(16):271–8.

[10] Nachtigall I, Lenga P, Jóźwiak K, Thürmann P, Meier-Hellmann A, Kuhlen R, Brederlau J, Bauer T, Tebbenjohanns J, Schwegmann K, et al. Clinical course and factors associated with outcomes among 1904 patients hospitalized with COVID-19 in Germany: an observational study. Clin Microbiol Infect 2020;26(12):1663–9.

[11] Deutschen Gesellschaft für Allgemeinmedizin und Familienmedizin (DEGAM). https://www.degam.de.(Accessed on 23 July 2020).

[12] Cuzick J. A wilcoxon-type test for trend. Stat Med 1985;4(1):87–90.

[13] Petrilli CM, Jones SA, Yang J, Rajagopalan H, O'Donnell L, Chernyak Y, Tobin KA, Cerfolio RJ, Francois F, Horwitz LI. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. BMJ 2020;369:m1966.

[14] Statistische Ämter: Fläche und Bevölkerung nach Ländern. http://www.statistikportal.de/de/bevoelkerung/flaeche-und-bevoelkerung.(Accessed on January 31, 2021).

[15] Korzilius H. Praxisalltag in Zeiten von Corona: Jeder versucht, das Beste aus der Situation zu machen. Dtsch Arztebl 2020;117(13):638–40.

[16] German Federal Bureau of Statistics. Current population. https://www.destatis.de/EN/Themes/Society-Environment/Population/Current-Population/_node.html.(Accessed on April 27, 2020).

[17] Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19). https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf.(Accessed on 29th June 2020).

[18] Remuzzi A, Remuzzi G. COVID-19 and Italy: what next? The Lancet 2020;395(10231):1225–8.

[19] Chang D, Xu H, Rebaza A, Sharma L, Dela Cruz CS. Protecting health-care workers from subclinical coronavirus infection. The Lancet Respiratory Medicine 2020;8(3):e13.

[20] Krist AH, DeVoe JE, Cheng A, Ehrlich T, Jones SM. Redesigning Primary Care to Address the COVID-19 Pandemic in the Midst of the Pandemic. The Annals of Family Medicine 2020;18(4):349.

[21] Lee A, Chuh AAT. Facing the threat of influenza pandemic - roles of and implications to general practitioners. BMC Public Health 2010;10(1):661.

[22] Rust G, Melbourne M, Truman BI, Daniels E, Fry-Johnson Y, Curtin T. Role of the Primary Care Safety Net in Pandemic Influenza. Am J Public Health 2009;99(S2):S316–23.

[23] Ärzteblatt (2020): POLITIK - Das Interview. https://www.aerzteblatt.de/archiv/214800/Das-Interview.(Accessed on 22 July 2020).

[24] Haserück A. Coronakrise: Telefonische Krankschreibung bis Jahresende möglich. Deutsches Arzteblatt 2020;117(43.).

[25] Ärzteblatt Coronakrise bringt Aufschwung bei Videosprechstunden. https://www.aerzteblatt.de/nachrichten/114528/Coronakrise-bringt-Aufschwung-bei-Videosprechstunden.(Accessed on January 31, 2021).

[26] Waschkau A, Steinhäuser J. Wandel des Bedarfs an Videosprechstunden in Zeiten einer Pandemie. Z Allgemeinmed 2020;96(7):317–24.

[27] Greenhalgh T, Wherton J, Shaw S, Morrison C. Video consultations for covid-19. BMJ 2020;368:m998.

[28] Bergman D, Bethell C, Gombojav N, Hassink S, Stange KC. Physical Distancing With Social Connectedness. The Annals of Family Medicine 2020;18(3):272.

[29] Steinman MA, Perry L, Perissinotto CM. Meeting the Care Needs of Older Adults Isolated at Home During the COVID-19 Pandemic. JAMA Internal Medicine 2020;180(6):819–20.

[30] Ärzteblatt: Weniger als ein Drittel der bestellten Schutzmasken eingetroffen. https://www.aerzteblatt.de/nachrichten/113799/Weniger-als-ein-Drittel-der-bestellten-Schutzmasken-eingetroffen.(Accessed on 30 Jun 2020).

[31] Ärzteblatt: Baden-Württemberg beschafft keine Schutzausrüstung mehr. https://www.aerzteblatt.de/nachrichten/113697/Baden-Wuerttemberg-beschafft-keine-Schutzausruestung-mehr.(Accessed on 30 June 2020).

[32] Robert Koch Institut: Coronavirus Disease 2019 - Daily Situation Report (31/03/2020). https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte/2020-03-31-en.pdf?__blob=publicationFile.(Accessed 8 July 2020).

[33] Jordan RE, Adab P, Cheng KK. Covid-19: risk factors for severe disease and death. BMJ 2020;368:m1198.

[34] Márquez EJ, Trowbridge J, Kuchel GA, Banchereau J, Ucar D. The lethal sex gap: COVID-19. Immun Ageing 2020;17(1):13.

[35] Jin J-M, Bai P, He W, Wu F, Liu X-F, Han D-M, Liu S, Yang J-K. Gender Differences in Patients With COVID-19: Focus on Severity and Mortality. Frontiers in Public Health 2020;8(152.).

[36] Lakhani HV, Pillai SS, Zehra M, Sharma I, Sodhi K. Systematic Review of Clinical Insights into Novel Coronavirus (CoVID-19) Pandemic: Persisting Challenges in US Rural Population. Int J Environ Res Public Health 2020;17(12):4279.

[37] Henning-Smith C. The Unique Impact of COVID-19 on Older Adults in Rural Areas. J Aging Soc Policy 2020;32(4–5):396–402.

[38] Souch JM, Cossman JS A Commentary on Rural-Urban Disparities in COVID-19 Testing Rates per 100,000 and Risk Factors. *The Journal of Rural Health* 2020, n/a.(n/a).

[39] Steinhäuser J, Scheidt L, Szecsenyi J, Götz K, Joos S. Perceptions of the local government about the primary care physicians shortage-a survey among mayors in the Federal State of Baden-Wuerttemberg. Gesundheitswesen 2012;74(10):612–7.

[40] Kopetsch T. The German healthcare system is running out of physicians! A Study on age structure and development of the number of physicians. Berlin: Bundesärztekammer und Kassenärztliche Bundesvereinigung; 2010.

[41] Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan. China: a descriptive study. The Lancet 2020;395(10223):507–13.

[42] Jain V, Yuan J-M. Predictive symptoms and comorbidities for severe COVID-19 and intensive care unit admission: a systematic review and meta-analysis. International Journal of Public Health 2020.

[43] Davino C, Fabbris L. Survey data collection and integration: Springer; 2013.

[44] Hummers-Pradier E, Martin H, Kochen MM, Heinemann S, Himmel W, Scheidt-Nave C. Simply no time? Barriers to GPs' participation in primary health care research. Fam Pract 2008;25(2):105–12.

[45] Kassenärztliche Bundesvereinigung: Statistische Informationenaus dem Bundesarztregister, Stand: 31.12.2019. https://www.kbv.de/media/sp/2019_12_31_BAR_Statistik.pdf.(Accessed 2 July 2020).