How Austrian primary care physicians formed their concept of care quality during the first ten months of the COVID-19 pandemic. A repeated cross-sectional survey research

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Abstract

Background. *In March 2020, Austria was among the first European countries to declare a national lockdown, responding to SARS-CoV-2 infections with a stringent ringfencing policy for inpatient beds. These interventions altered access to the Austrian healthcare system. This study aims to understand demand- and supply-side factors influencing Austrian Primary Care Physicians' (PCPs') assessment of their care quality during the first ten months of the COVID-19 pandemic.*

Methods. *The study deployed a cross-section design based on stratified random sampling, where all Austrian PCPs (split into three disjointed random samples) were invited to participate in an online questionnaire (in May, September and November 2020, respectively). A multinomial logit model analyses the three sets of cross-sectional survey data. The study subjects are all 6,679 Austrian PCP (2020) with a registered practice. The total sample size was 403 (corresponding to a net response rate of 6.3%).*

Results. *The primary outcome was the PCPs' evaluation of their care quality. Secondary outcomes were "patient behaviour and wellbeing" (five questions), with Cronbach's alpha of 0.74, and the PCPs' "pandemic preparedness" (five questions) with a smaller internal consistency (0.69). 47% of the PCPs rated their care quality during the first ten months of the pandemic as worse than before the outbreak of COVID-19. The overall assessment correlates to the pandemic stage, lack of preventive care and mediocre information exchange/cooperation within the medical profession. Towards the end of the first lockdown, PCPs' care quality perception was exclusively shaped by the availability of SARS-CoV-2 tests at the practice.*

Conclusions. *With improved resource supply towards the end of 2020, demand-side factors like the uptake of medical check-ups and screenings increasingly defined PCPs' quality perception. Also, respondents described waiting times for elective specialist care as significantly increasing during lockdown periods. However, they did not include them when perceiving their care quality.*

BACKGROUND

In most countries, primary care is the backbone of healthcare delivery [1, 2], where Primary Care Physicians (PCPs) ensure access to specialist services and orchestrate continuity of care [3], even during crises like a pandemic situation [4–6]. This undertaking is vital because continuity of care is strongly related to care quality, patient adherence to medical advice, patient satisfaction and patient mortality [4, 7–9]. The COVID-19 pandemic has, however, impaired this continuity and put unprecedented pressure on healthcare systems and the people within.

The study presented in this paper was conducted in a healthcare setting (Austria), where access to specialist services is barrier-free as predominantly delivered in public and private practices in primary care. Without any gatekeeping function, registering with a PCP is not mandatory. Still, Austrian PCPs are often the first point of contact for all issues around disease and care [10]. This is particularly the case in rural areas, while medical consultants with public primary care practices frequently serve as the first point

of contact in the urban context. This easy access to specialist services might have contributed to the resilience of Austria's healthcare system in the past. Also, sufficient "redundancies" in financial and personnel capacity should have prepared the Austrian healthcare system well to deal with a shock like the COVID-19 pandemic [11]. For example, with 6,679 PCPs with practices registered in 2020, the ratio of 1.5 PCP per 1,000 inhabitants was one of the highest of all OECD countries [12, 13]. The same applies to Austria's inpatient bed capacity. With 7.3 hospital beds per 1,000 inhabitants, Austria outranked most other OECD countries in the 2020 survey (e.g., the UK provided 2.5 hospital beds per 1,000 inhabitants) [13]. Nonetheless, the structure of the Austrian Healthcare system is based on federalism, whereof inpatient care is in responsibility of the federal states and outpatient care – irrespective whether of primary or secondary care – is in responsibility of the cooperative partners (chamber of medicine and statutory health insurances) [10]. This means that Austrian federalism tend to highly siloed thinking in inpatient, outpatient, and public health care [14]. Even more the PCP sector is more dependent from the local public health authorities, who are located at the municipality level [10]. During the first year of the pandemic, responsibility for detecting and treating COVID-19-infected patients was taken away from the PCPs. It was handed over to public health authorities, especially to the 1450 hotline of the emergency service system and hospital facilities. Still, inpatient bed capacities were stretched thin during more recurrent COVID-19 peak-demand periods. Austria's primary care (sidelined by public health policy in the context of pandemic management) struggled with treating the non-infected [15–17]. I.e., the pandemic has revealed and aggravated structural deficits in the Austrian healthcare system (as opposed to exposing mere resource shortages).

To provide a real-time assessment of the capability of a healthcare (sub)system to cope with a crisis, one would ask for comprehensive data on epidemiology, services provided, and diagnoses. However, Austria's primary care does not offer these data due to a lack of diagnostic coding for all healthcare services outside hospital walls. Consequently, the idea was born to draw upon the experience and (self)perception of PCPs to understand better the care quality during a healthcare crisis. In this context, the assessment of PCPs seems to be a good opportunity for timely highlighting (potential) supply shortages (and their consequences) regarding the provision of high-quality medical care and community-oriented public health services [1, 18, 19]. The WHO framework conceptualises care quality as "*the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with evidence-based professional knowledge*"[20]. The Institute of Medicine pins down six quality domains: (1) effectiveness, (2) safety, (3) timeliness, (4) people-centeredness, (5) equity and (6) efficiency of health services. In primary care, *timely* care in a *safe* environment has received particular research attention during the COVID-19 pandemic to maintain healthcare *effectiveness* [6, 21–24].

The present study is designed to do three things. First, the study seeks to provide insight into what PCPs were thinking about the care situation of their patients over the first ten months of the pandemic in Austria. Using their assessment to understand how a disease like COVID-19 alters the care quality of their patients is a novel approach to health service research. Second, this study seeks to understand better which factors shape PCPs' care quality assessment at what point in time. Thus, this study will provide some hints on how the concept of care quality, as perceived by PCPs, is formed and whether it

immediately reflects the status quo. Third, the results of this study will allow us to infer whether, in a crisis, the PCP's quality assessment could be a real-time indicator of current and upcoming issues in primary care when epidemiological and diagnostics data is missing. Therefore, we use high-level retrospective data from the Austrian Board of Auditors, published in late 2021, to ex-post validate PCPs' evaluations and perceptions [25]. We also validate our results using qualitative insights derived by other studies [17]. The following questions guide our research:

1. How did PCPs perceive their level of preparedness for the COVID-19 pandemic at three different time points in 2020?
2. How did PCPs assess their patients' behaviour, access restrictions to specialist treatment and wellbeing over the first ten months of the COVID-19 pandemic?
3. How did PCPs assess the care quality of their patients over the first ten months of the COVID-19 pandemic?
4. How did PCPs' ratings on questions 1 and 2 affect their overall quality assessment (question 3)?

I.e., this study intends to contribute to identifying issues (like potential structural weaknesses) which should be addressed to strengthen the resilience of the Austrian and like-wise healthcare systems [26].

METHODS

Study design and sampling method

We used a repeated cross-sectional research approach to capture the health service expertise of Austrian PCPs over the first ten months of the COVID-19 pandemic. Emanating from core questions about the respondents' perception of Austrian disease control management, we requested the PCPs to share their opinion about the care situation of their patients (extending their judgement to the provision of specialist outpatient and inpatient care). The questionnaire was based on the *Survey of Primary Care Physicians of the Commonwealth Fund*, tweaked to reflect COVID-19 conditions [27]. We randomly selected three disjointed samples from the official mailing list of Austrian PCPs. We emailed the same questionnaire to the three stratified random samples at three distinct points in time. The first sub-sample (first third of addresses randomly drawn from the official mailing list) was approached in late May 2020, i.e., towards the end of the first COVID-19 lockdown in Austria. The second sample (second third of the randomly drawn addresses) was approached in September 2020, and the third randomly drawn sample was contacted in November 2020. Thus, we created three non-intersecting, independent cross-sections. We will refer to the first response period (late May until early July 2020) as "spring" to ease readability. The second response period, from early September to mid-October 2020, will be labelled as "summer" and the last one (from November to just before Christmas 2020) as "winter". The required sample size with a 5%-tolerance of the sampling error and a 95% confidence interval was $\overline{n} \geq 364$, based on the 2020 number of PCPs ($N = 6{,}679$; Ärztekammer, 2021).

Statistical methods

We started the analysis by calculating the descriptives and investigating the statistical differences via the Mann-Whitney-U test for comparing two samples and the Kruskal-Wallis-H test (χ^2) for comparing more than two samples. For testing internal consistency, we computed Cronbach's alpha. Further, we used a multinomial logistic regression (logit) model to understand which factors, viz. variables, mattered for the *PCPs' care quality assessment* throughout the first ten months of the COVID-19 pandemic. This statistical classification model extended the logistic regression from binary to multiclass problems, i.e., problems with a dependent categorical variable with more than two possible outcomes k. In our case, the dependent categorical variable (y) was care quality with the possible outcomes "Improved ($k = 1$)", "Remained the same ($k = 2$)", and "Deteriorated ($k = 3$)".

Choosing "Remained the same" as the reference category, we arrived at the following multinomial logit model consisting of two independent binary regression models, where the other two outcomes, "Improved" and "Deteriorated", were regressed against the reference category, i.e.,

$$\log\left(\frac{\mathbb{P}\left(y=k\right)}{\mathbb{P}\left(y=2\right)}\right)=\alpha_k+\beta_{k,1}x_1+\cdots+\beta_{k,15}x_{15}\left(k=1,3\right),$$

(1)

where α_k indicated the intercept with the ordinate. The terms $\beta_{k,j}$ ($k=1,3; j=1,\ldots,15$) represented the change in the odds of the care quality being in category k compared to being in the reference category ($k = 2$), associated with a one-unit change of the corresponding explanatory variable x_j ($j=1,\ldots,15$). The variables $x_1,\ldots,x_5$ operationalised pandemic preparedness to understand the influence of resource supply in healthcare on the variable *care quality*. The variables $x_6,\ldots,x_{10}$ covered demand-side issues like patient behaviour, access to treatment and patient wellbeing to reveal their potential relationship with *care quality*. Finally, $x_{11},\ldots,x_{15}$ addressed various variables like the number of (COVID-19) patients, the number of PCPs in the practice, and the period of responding to the survey.

We used SPSS (IBM, version 28.0.1) for statistical analyses throughout the paper. The cut-off level for statistical significance was 0.05. For model-fit evaluation, we used the recommendations from Cohen [28]. Reporting followed the STROBE statement for cross-sectional studies (see supplementary file).

RESULTS

Sample

During the first survey period (late May until early July 2020), we collected $n_1 = 104$ responses. During the second period (early September until mid-October 2020), we accumulated $n_2 = 148$ responses. During the third survey period (coinciding with the second COVID-19 lockdown in Austria), we obtained $n_3 = 169$ responses. I.e., we received a total of $421 > \overline{n}$ responses, corresponding to a net response rate of 6.3%. Data cleansing forced us to remove 12 responses due to a missing indication of physician age. We used official 2020 Austrian Physician Statistics data to check the sample for external validity

[12]. The sample share of female PCPs of 43.6% and the average quarterly number of patients of 1,285 (see Table 1) mimicked the characteristics of the 2020 statistics. However, as underpinned by Table 2, we observed a minor overrepresentation of respondents in the 45-64-year bracket. Younger doctors between 35 and 44 and PCPs over 64 were somewhat underrepresented in our sample. We, therefore, used the relative differences in physician age (see Table 2, column 4) as weights to correct the sample data for age disparities.

Table 1
Sample characteristics

Gender ($\varvec{n = 409}$**)**	
Female	186 (45.5%)
Male	220 (53.8%)
Other	3 (0.7%)
PCP consultations	
Average number of patients per quarter ($\varvec{n = 383}$)	Mean: 1,285 (SD: 793.5)
Average number of COVID-19 patients per quarter ($\varvec{n = 377}$)	Mean: 32 (SD: 54.9)

Table 2
Comparison of the sample age distribution and the 2020 Austrian Physician Statistics

Age	**Sample % (**$\varvec{n = 403}$**)**	**Physician Statistics % (**$\varvec{N = 6{,}679}$**)**	**Difference**
up to 34	2.0	2.0	-0.0
35 to 44	18.4	19.2	-0.8
45 to 54	30.5	29.2	+ 1.3
55 to 64	40.9	36.1	+ 4.8
65 and older	8.2	13.5	-5.3

Descriptive results regarding some of healthcare's supply- and demand-side factors

Asking PCPs about the extent of being prepared for the pandemic provided a proxy for actual healthcare capacity as it seized primary care's capability of serving non-COVID-19-related (elective and emergency) requests. We derived insight into the PCPs' level of preparedness by analysing the responses to a set of five questions (see Fig. 1).

--Figure 1 about here—

Figure 1: Supply-side factors for care quality assessment

We found that, throughout 2020, PCPs' evaluations of *coordination and information exchange within the medical profession regarding COVID-19 measures and treatment* were neither good nor particularly bad. Also, these evaluations did not significantly improve throughout the first pandemic year (see row 1, Fig. 1). The *support of agencies acting on behalf of the Austrian government (regarding implementing protective disease control measures)* was evaluated as very poor early in the pandemic, with evaluations getting a little better after June 2020. Here, it is critical to emphasise that, despite the improvement's statistical significance, the PCP's satisfaction with governmental support remained at an insufficient level for the whole of 2020 (see row 2, Fig. 1).

Furthermore, PCPs confirmed that the supply of *general* and *COVID-19-specific safety and hygiene equipment* did not improve significantly before the second lockdown started on 17 November 2020 (see rows 3 and 4, Fig. 1). The same was observed regarding the *availability of SARS-CoV-2 tests in PCP practices* (see row 5, Fig. 1). The gap between the lines in Fig. 1 visualises that procuring and distributing safety equipment within Austria's primary care sector was not satisfactory until mid to late autumn 2020. The internal consistency of the five questions on a PCP's preparedness for a pandemic crisis (as depicted by Fig. 1) was nearly acceptable, with a Cronbach's alpha of 0.69.

After this look at healthcare's supply side, we now examine aspects of healthcare's demand side by analysing changes in patient behaviour perceived throughout 2020, which were operationalised by the two top survey questions in Fig. 2. Two more questions collected the PCPs' assessment of accessibility to specialist services. The last question delivered a proxy for the wellbeing of their patients. The internal consistency of these five questions was validated by a Cronbach's alpha of 0.74.

--Figure 2 about here—

Figure 2: Demand-side factors for care quality assessment

On the one hand, Fig. 2 shows that PCPs consistently expressed concerns about their patients *skipping medical check-ups and screenings* (row 1, Fig. 2). On the other hand, patients *who did not seek medical attention (even when acutely unwell, in case of an accident or an injury)* seemed to be a matter of concern only during the first COVID-19 wave (row 2, Fig. 2). *Long waits for specialist*

diagnostics/treatment (in Austria, mainly provided outside hospital walls) may have become significantly shorter after the first pandemic wave, but not to the extent that PCPs would no longer regard them as a problem (see row 3, Fig. 2). Similarly, patients had to cope less often with *elective inpatient care being cancelled.* However, ongoing delays of elective procedures were still too frequent for PCPs to perceive the problem as solved (see row 4, Fig. 2). Furthermore, PCPs' agreement level with patients experiencing drawbacks was more pronounced for secondary than specialist care [29].

The concluding question in Fig. 2 relates to PCPs' assessment of patient wellbeing. Somewhat unsettling is that PCPs confirmed throughout 2020 that their *patients develop psychiatric disorders that can be traced back to disease control measures*. Therefore, it feels comprehensible that 47% of the survey respondents thought their patients' *care quality* had deteriorated since the pandemic's onset, 7% responded that *care quality* improved, and 46% answered that the *quality* remained the same.

The following section will investigate whether a systematic relationship within the data can explain PCP assessment of care quality. I.e., we seek to determine which of the facets of preparedness for the pandemic (see Fig. 1) and patient behaviour, access restrictions to specialist care and patient wellbeing (see Fig. 2) correlated to the PCPs' quality assessment. The analysis will help understand what shapes PCPs' perceptions of care quality and whether a particular pattern or focus of attention (like safety or effectiveness) can be read off that varies with the course of the pandemic.

Results from the analysis of care quality drivers

Figure 3 shows the results of our multinomial logistic regression model. We estimated the model stepwise to identify which variables explain the variable *care quality* accurately. As differentiated in Fig. 3, we split the estimations into the supply-side model (1), the demand-side model (2), and the mixed model (3). I.e., the supply-side model (1) incorporates the explanatory variables $x_1, \ldots, x_5, x_{11}, \ldots, x_{15}$ and the demand-side model (2) includes $x_6, \ldots, x_{15}$. Finally, the mixed model (3) integrates all 15 explanatory variables into the regression. We cross-validated the model with an 80/20 random sample and found high cross-validity for model (3) explanatory variables.

We analysed two more models since we found that the response period was relevant for explaining care quality according to model (3). The resulting spring (4) and winter (5) models then allowed for gathering extra insight into potential shifts of the quality indicators, depending on the current stage of the pandemic. The winter model (5) showed that demand-side variables explained care quality towards the end of 2020, while (a) supply-side variable(s) showed a better fit in the early days of the pandemic. Specifically, *skipped check-ups and screenings* are the primary explanation for the deterioration in *care quality* in the winter model (OR = 1.956, 95%CI=[1.081,-3.540]).

All models showed a good fit based on Cohen's recommendation [28]. Specifically, the model fit is satisfactory for the mixed model (3) with a log-likelihood of 377.620 (χ^2=89.377 $p < 0.001$), an AIC of 441.620 and a Nagelkerke's Pseudo R^2 of 0.351. The spring model (4) showed a good model fit with a log-likelihood of 21.585 (χ^2=48.702 $p = 0.004$), AIC of 77.585 and Nagelkerke's Pseudo R^2 of 0.853. The

winter model (5) exhibits a model fit of 195.383 (χ^2=60.379 $p < 0.001$), AIC = 251.383 and a Pseudo R^2 of 0.424.

–Figure 3 about here—

Figure 3: Multinominal regression analyses

Whenever *coordination and exchange of information within the medical profession (regarding COVID-19 measures and treatment)* had been evaluated as poor, models (1) and (3) revealed slightly higher odds that PCPs assessed *care quality* as deteriorating than PCPs evaluating *care quality* as unchanged (OR: 1.455; 95%CI=[1.009, 2.097]). Interestingly, neither *support from government agencies* nor the *availability of (general and COVID-19-specific) equipment* impacted the PCPs' overall assessment of care quality. However, models (4) and (5) disclosed that in June 2020, PCPs evaluated *care quality* as deteriorating when the *availability of SARS-CoV-2 tests in their practice* was poor or very poor (OR: 14.838, 95%CI= [1.349, 163.199]). Later in the first pandemic year, the *availability of SARS-CoV-2-tests* no longer shaped the quality concept of PCPs. In other words, what defines *care quality* for physicians has morphed alongside the phenotype of the pandemic problem.

From models (2) and (3), we learned that, overall, the odds of assessing *care quality* as deteriorating were high when PCPs had observed that their *patients skipped medical check-ups and screenings* (OR = 2.147, 95%CI=[1.363, 3.383]). At the same time, *elective inpatient treatments not taking place* and *patients developing psychiatric disorders* were irrelevant to the overall *care quality* assessment of PCPs. *Long waiting times for specialist treatment* (OR = 1.444, 95%CI=[1.038, 2.008]) seemed relevant for the *care quality* assessment of PCPs only in the context of the demand-side model (2). Interestingly, the relevance of *patients no longer seeking medical attention (even in acute illnesses, accidents, or injuries)* disappeared as a driving force for PCPs' *care quality* assessment when moving from model (2) (OR = 1.541, 95%CI=[1.065, 2.230]) to model (3). In other words, when adding the supply-side variables, we found that the information exchange/cooperation within the medical profession (on the supply side) guided the quality concept of PCPs rather than long waits for specialist care or suspended acute treatment.

DISCUSSION

In analysing survey responses of PCPs, this study aimed to understand how COVID-19 and the public health measures to fight the disease have affected Austria's primary care sector and how the status quo shaped physicians' concept of "care quality". Multinomial logistic regression uncovered distinctive differences in this concept across the pandemic stages in 2020.

Towards the end of the first COVID-19 wave in late spring 2020, PCPs associated care quality with the availability of SARS-CoV-2 tests within practice walls [17]. Austrian PCPs also raised severe concerns about the lack of proper allocation of protective equipment across the healthcare system [17, 30, 31]. So, there was a focus on healthcare's supply side, reflecting a system struggling to provide necessities to

handle patient flows in an unprecedented situation. In this context, it is plausible that the assessment of PCPs focused on the safety dimension of healthcare quality [21]. Resource supply (safety equipment, SARS-CoV-2 tests) improved towards the onset of the second wave in November 2020. Thus, “quality” was perceived (by PCPs) as a demand-driven concept (i.e., determined by patient behaviour). Austria’s PCPs were deeply concerned about their patients no longer undergoing medical check-ups and screenings, significantly influencing PCPs’ real-time quality assessment.

By the end of 2021, the Austrian Board of Auditors confirmed that PCPs’ concerns were more than just pandemic-induced doom-mongering. The Board reported that in 2020, preventive check-ups in primary care had declined by 135,000 (-10%) compared to the previous year [25]. Also, screenings in secondary care were negatively impacted. For example, colonoscopies in outpatient departments decreased by 76% in April 2020, regained 2019 levels, and collapsed again in November/December 2020 (-40% compared to 2019 levels) [25]. Austria’s outpatient departments experienced a similar pattern for mammograms [25]. Follow-up effects are still unclear, with data not yet lending themselves to statistically significant results about long-term effects on **healthcare’s effectiveness** (a core dimension of healthcare quality). Still, researchers have expressed concerns regarding inadequate healthcare provision for the non-infected, especially vulnerable populations [17, 32–36]. A study comparing survey data on health and social issues for the Austrian population between 2015 and 2020 named delayed treatment and non-available providers as the primary reasons for Subjectively Unmet Needs (SUNs) [37]. Pandemic-related SUNs have been predominantly observed in people with poor health, older age groups (50–64 years) and inactive and retired persons. Additionally, the prioritisation of Austria’s secondary care in the form of ringfencing beds to prepare for an expected increase of COVID-19 inpatients potentially aggravated chronic health conditions of primary care patients due to a lack of care continuity [6, 38]. The latter correlated with dodging acute treatment and increasing societal mental health problems [39, 40]. These arguments support the notion that persons with more substantial healthcare needs have experienced restrictions in access to care, thus eroding the principle of **equity in healthcare** (another core dimension of healthcare quality) [41].

Throughout 2020, Austria’s PCPs also worried (significantly more during the first wave than the second) about delayed or cancelled elective treatment in hospitals. Indeed, bed days in funds hospitals dropped by 1.8 million (-15%), with hip and knee replacements declining by 19% compared to 2019 [25]. Inpatient stays with a cancer diagnosis in Austria experienced the most substantial decline in April and May 2020, with − 24% compared to the previous year; in November and December, it was up to -16% [25]. Nonetheless, the **timeliness of care** (another core quality dimension) did not contribute to explaining the overall quality assessments of Austrian PCPs. A potential reason is that secondary care did not inform the PCPs directly about cancelling an elective operation. So, PCPs would not have instantly known that one of their patients was (potentially negatively) affected. Then, it would make sense that, during a pandemic, PCPs did not include timeliness in their quality perceptions.

Except for the impact of the short supply of SARS-CoV-2 tests, even in the early phase of the pandemic, the **safety dimension of quality** seemed less critical for PCPs in their quality assessment than expected.

This correlated with the observation that *fear of infection keeping patients away from acute healthcare* (a concern during the first COVID-19 wave) was no driver of the assessment of care quality either. A possible reason is that the delivery of primary care services changed remarkably throughout 2020 [2, 30, 42–44]. Face-to-face contacts declined from 70–23%, while the number of telemedicine contacts increased broadly [45]. An Austrian study specifically reported that 77% of 606 contacted physicians who responded to their survey considered "telemedicine as the one key element for maintaining care in the current healthcare crisis" [46]. Telemedicine enabled effective and safe (and often timely) care and assisted primary care's pandemic-induced focus on chronic disease management, medical screenings and check-ups [38, 40].

PCPs' quality perception adjusted over time and reflected the most pressing issues in primary care in real time. Therefore, it is even more remarkable that throughout 2020, PCPs perceived proper coordination (and information exchange) within the medical profession as one of the key resources preventing even further decline in the care quality of their patients. There is, however, room for improvement. For example, the Austrian Board of Auditors recommended a well-established (bidirectional) exchange of information and the obligated cooperation of national health insurance institutions, hospitals and public health agencies to provide the best possible use of resources in a health crisis [25]. As a best-practice example, Australia's successful response to the pandemic included regular webinars and teleconferences with primary care professionals to enable continuous and two-way communication with the primary care workforce [47].

Early in the pandemic, the Austrian Ministry of Health allegedly presumed that the health insurance institutions would continue to regulate primary care but did not systematically integrate them at the state level into national disease management. At the federal level, health insurance institutions were not integrated at all, and their resources were not used for disease control. Hence, it is no surprise that PCPs' evaluations of the support from governmental public health agencies did poorly, and the public's compliance with disease control measures eroded over time [15]. Undeniably, the strong siloed separation between care services and public health authorities has been a weakness of the Austrian healthcare system revealed by the pandemic [19, 48]. This study emphasises the necessity of better integrating primary care and public health to bolster the resilience of the Austrian healthcare system and safeguard care quality in case of crises or disasters [18]. Specifically, the study's findings advocate a more substantial involvement of PCPs in Austria's public health planning.

The system resilience framework states that sustainable healthcare systems must shift activities from inpatient care to primary care [26, 48]. PCP responses in the survey allude to a substantial degree of **patient-centeredness**, putting the patient at the heart of care processes. For example, PCPs expressed more profound concern about their patients' health than personal concerns like substantial financial losses or their own risk of infection [29]. The latter is more than just paying lip service as nearly 30% of Austrian PCPs are over 60 years old and, thus, at risk of severe (COVID-19) disease.

Thus, acting at the forefront of Austria's fragmented healthcare system, PCPs are presumably the only stakeholders in healthcare with a somewhat comprehensive picture of the health state of their patients. Their knowledge should be used for timely and needs-based public health planning.

Strength & Limitations

Unlike most studies on shifting and rearranging duties and responsibilities during the COVID-19 pandemic, our study is quantitative with a good sample size. It resonates with several qualitative studies and confirms their results [17, 24, 43, 45, 49, 50]. Additionally, independent data validate the quality perception of PCPs discussed in this paper [25]. However, since we have analysed the quality concept at different pandemic stages, a panel design would have been superior to our cross-sectional design. Nonetheless, the insight into the pandemic waves (first lockdown, summer recess, and second lockdown) and perceptions of care quality constitute an asset and show the capability of primary care to adapt.

Statistically, there are some limitations regarding the generalisability of our data. For example, the multinomial logistic regression results have a good model fit (suggesting internal validity). However, there is an issue within the dependent variable (the assessment of "care quality"). I.e., answers are limited to the subjective evaluation of overall care quality without any refined explanation if this improvement/deterioration roots in outpatient or inpatient care. Also, quality domains (effectiveness, safety, timeliness, people-centeredness, equity and efficiency) were not operationalised by standardised survey questions as we focused on adapting the *Survey of Primary Care Physicians of the Commonwealth Fund* for COVID-19. Also, some variables that affect PCP assessment of care quality might not be included in our regression model. For example, analysis of open questions from the survey revealed that PCPs were highly concerned about delayed medical examinations by specialists and in specialised outpatient clinics as they caused a delay in diagnostics and treatment of their patients [29].

CONCLUSION

The study suggests that PCPs form quality perceptions that adjust to the most pressing issues in real time. This quality concept (analysed in a pandemic context) focuses on the effectiveness and safety of healthcare provision. Thus, PCPs' quality assessment might be a real-time indicator of issues in primary care and a proxy for missing data on epidemiology, services provided, and diagnostics.

Despite primary care's high adaption speed in Austria, it took public health authorities until the second lockdown in December 2020 to sufficiently strengthen its supply side. This did not correspond to restoring pre-pandemic continuity of care as patients had changed their health behaviour over the first pandemic year and skipped medical check-ups and screenings. The study underlines that siloed thinking and the strict separation between treating COVID patients and non-COVID patients (especially during the first wave) had tremendous effects on the care quality perception. Especially, the strict financially and structural differences – based on legal regulations – between inpatient and outpatient care in Austria has

seen as problem for care quality. As a result, acute treatment declined, while waiting times for elective inpatient care increased significantly.

Declarations

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Contribution. AB and EK developed the study design and the analysis. AB was responsible for data analysis and statistics. EK developed the theoretical framework and conducted the sampling plan. DB was responsible for data analysis, discussion, and cross-checking of the results with the epidemiological data from the public authorities. Writing the manuscript was undertaken by all three authors at varying extent. All three authors contributed substantially towards the interpretation of results.

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Conflict(s) of Interest. The authors of this manuscript declare that they have no competing financial, professional, or personal interests that could have impacted the quality or presentation of their work.

Consent for publication. Not applicable.

Ethics approval and Consent to participate. The study was following the ethical guidelines of good scientific practice, the EU-General Data Protection Regulation, and the Declaration of Helsinki. The regulations of the Austrian Board of Ethics Committees require authorisation for investigating vulnerable groups, intervention studies and pharmaceutical trials. None of these criteria applies to the study presented here. Furthermore, the study does not qualify for healthcare or medical research, focusing on generating new knowledge about disease or health. Thus, this study was exempt from ethical approval under Austrian Health Research regulations. Under Austrian law, a waiver is given only for approved research and not if no ethical approval is needed. Written information was provided to participants before the distribution of the surveys. Participants provided informed consent as online surveys contained the following statement for the participants: "By clicking to move forward to complete this survey, I agree to participate in this study." Data collection was anonymous.

Availability of data and materials. The survey participants have explicitly agreed to restrict the use of their responses solely for this research, thereby denying public access to the raw data.

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Figures

Supply-side factors	Difference and p-value	very good (1)	good (2)	poor (3)	very poor (4)
How would you describe the coordination and the exchange of information within the medical profession regarding COVID-19 measures and treatment? (n=411)	$\chi^2(2)=4.300$, p=0.116				
How would you describe the support of government agencies (like the Health Department or AGES) concerning the implementation of protective measures? (n=403)	$\chi^2(2)=10.45$, p=0.005				
How would you describe your practice's stock of general safety equipment (virucidal disinfectants and mouth-nose protection)? (n=419)	$\chi^2(2)=30.292$, p<0.001				
How would you describe your practice's stock of specific safety equipment (FFP2 or FFP3 masks and Personal Protective Equipment (PPE) like clothing)? (n=418)	$\chi^2(2)=44.640$, p<0.001				
How would you describe your practice's stock of SARS-CoV-2 tests (PCR, antibody and rapid tests)? (n=398)	$\chi^2(2)=94.515$, p<0.001				Spring Summer **Winter**

Figure 1

Supply-side factors for care quality assessment

Demand-side factors	Difference and p-value	strongly agree (4)	agree (3)	disagree (2)	strongly disagree (1)
Due to the pandemic, patients no longer undergo medical check-ups and screenings. (n=414)	$\chi^2(2)=24.982$, p<0.001				
Due to the pandemic, patients no longer seek medical attention, even in cases of acute illnesses, accidents or injuries. (n=412)	$\chi^2(2)=15.705$, p<0.001				
Due to the pandemic, patients must accept long waiting times for specialist treatment. (n=411)	$\chi^2(2)=18.867$, p<0.001				
Due to the pandemic, patients must accept that necessary elective inpatient treatments do not take place. (n=412)	$\chi^2(2)=41.037$, p<0.001				
Patients develop psychiatric disorders that can be traced back to disease control measures. (n=407)	$\chi^2(2)=1.523$, p=0.467				Spring Summer **Winter**

Figure 2

Demand-side factors for care quality assessment

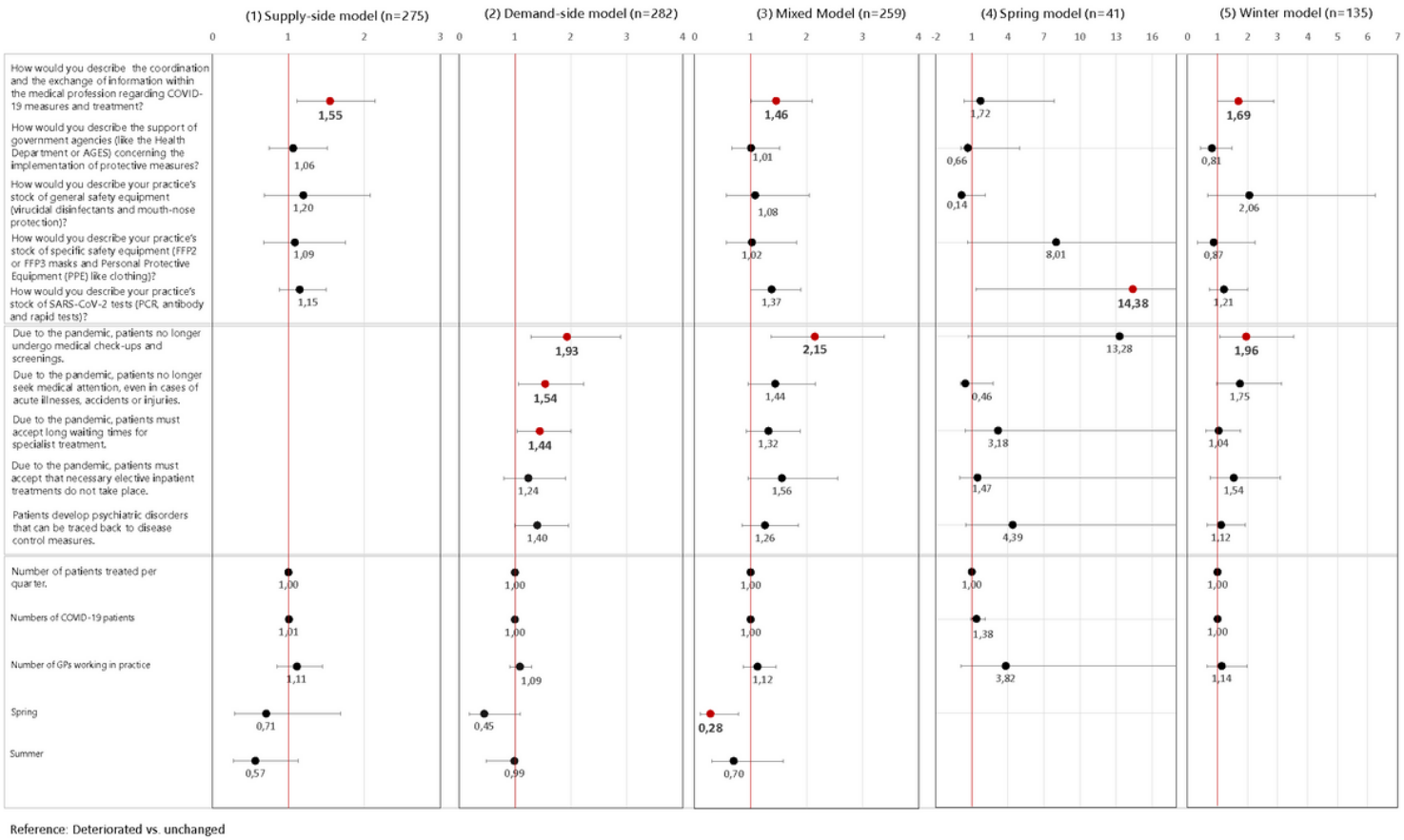

Figure 3

Multinominal regression analyses

Supplementary Files

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- STROBEchecklistPHCQoC.doc