Effects of closure of the paediatric department of a district hospital on regional care: analysis of patient flows

Auswirkungen der Schließung der pädiatrischen Abteilung eines Kreiskrankenhauses auf die regionale Versorgung – Analyse der Patientenflüsse

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ABSTRACT

Background The consequences of economization and staff shortage in the German health care system strongly affect paediatric care structures, especially in rural regions. It is not known how closures of paediatric departments influence patient flows of surrounding hospitals. Here, we investigate the quantitative effects of closure of the paediatric department of a district hospital and the subsequent opening of an alternative inpatient service on the utilisation of inpatient and outpatient care services of the two neighboring hospitals and the emergency services of the region.
Methodology In the observation period from 2015 to 2019, patient-related data from the three hospitals in the study region as well as data from the rescue service were evaluated.
Results In the year after the paediatric department of the district hospital was closed in 2016, the total number of inpatient cases in the region decreased by 33 % (2015: n = 1,787; 2016: n = 1,193) and then decreased by an additional 11 % (2019: n = 1,005). The number of outpatient cases decreased by further 8 % (2015: n = 6,250; 2019: n = 5,770). In the last observation year, emergency services were used much more frequently than in the year before the closure (2015: n = 398; 2019: n = 572). This means an increase of 44 %.
Conclusion After the closure of the paediatric department, the total number of inpatient cases in the region fell sharply. However, actual gaps in care apparently did not arise. Before closing, the consequences for the surrounding hospitals should be assessed more precisely. Real gaps in care must be counteracted, e. g. through alternative outpatient services.

ZUSAMMENFASSUNG

Hintergrund Die Folgen der Ökonomisierung und der Personalmangel im deutschen Gesundheitswesen treffen pädiatrische Versorgungsstrukturen stark, insbesondere in ländlichen Regionen. Es ist kaum bekannt, wie sich Schließungen pädiatrischer Abteilungen auf Patientenströme umliegender Krankenhäuser auswirken.

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Fragestellung Welche quantitativen Auswirkungen haben die Schließung der pädiatrischen Abteilung eines Kreiskrankenhauses und die nachfolgende Eröffnung eines ambulanten Versorgungsangebots auf die Inanspruchnahme der Versorgungsleistungen der beiden benachbarten Krankenhäuser und den Rettungsdienst der Region?

Methodik Im Beobachtungszeitraum 2015 bis 2019 wurden Patientendaten der drei Krankenhäuser der Beobachtungsregion sowie Daten des Rettungsdienstes des Landkreises gemeinsam ausgewertet. Eingeschlossen wurden Patienten unter 18 Jahren aus 12 Postleitzahlenbereichen.

Ergebnisse Im Jahr nach der Schließung der Pädiatrie des Kreiskrankenhauses in 2016 verringerte sich die Gesamtanzahl der stationären Fälle der Region zunächst um 33 % (2015: n = 1.787; 2016: n = 1.193) und reduzierte sich dann noch um weitere 11 % (2019: n = 1.005). Die Anzahl ambulanter Fälle verringerte sich insgesamt um 8 % (2015: n = 6.250; 2019: n = 5.770). Im Jahr 2019 war der Rettungstransportwagen wesentlich häufiger im Einsatz als im Jahr vor der Schließung (2015: n = 398; 2019: n = 572). Dies bedeutet eine Steigerung um 44 %.

Schlussfolgerung Nach der Schließung der Pädiatrie-Abteilung verringerte sich die Gesamtanzahl der stationären Fälle in der Region stark, tatsächliche Versorgungslücken sind offenbar aber nicht entstanden. Vor einer Schließung sollten die Folgen für die umringenden Krankenhäuser genauer eingeschätzt werden. Echten Versorgungslücken muss entgegengewirkt werden, z. B. durch alternative ambulante Angebote.

Introduction

Over the past 30 years, one in five German paediatric departments has been closed. In rural regions, this has repercussions for paediatric care available in the local area [1]. In contrast to these numbers, there are growing numbers of people under the age of 18 who are chronically ill or who suffer from mental illness, with a growth in demand for paediatric treatments expected in the future [2–4].

The need to concentrate capacities for providing medical care, for quality and economic reasons, leads to the supply of such care being spread more thinly [5–7]. Germany's area-states, such as Mecklenburg-Vorpommern and Bavaria, have found themselves in the spotlight of both the media and health policy due to temporary or permanent closures of paediatric departments in emergency care [8, 9]. Such closures lead to children in need of treatment being rejected by emergency departments (ED) which lack paediatric expertise, or else being treated in adult departments [2, 10]. Even back in 2018, 4.8 % of those under 18 years of age in Germany had to travel for more than 40 minutes by car to reach a paediatric hospital department [11].

If a paediatric department closes down, then the surrounding hospitals have to take on the additional demand and admit patients. By applying an analysis from a health-economics model of the paediatric hospital landscape in the district of Vorpommern-Greifswald, it has been shown that a positive contribution to margins (i. e. the hospital revenue following deduction of employment-related costs is greater than zero) could only be achieved in this region if two out of three paediatric departments were closed. This would worsen accessibility for 8 % of those under the age of 18 [12].

To the best of our knowledge, the effects that closures actually have on the use of surrounding hospitals have not been investigated to date. In this analysis, the effects of the closure of the Department of Paediatrics of the Wolgast District Hospital on the use of outpatient and inpatient services in hospitals in the Ostvorpommern region (Wolgast/Anklam/Greifswald) as well as on the rescue services were investigated.

Following the closure of the Department of Paediatrics in Wolgast, a town with a population of 12,000, on 1 February 2016, a Paediatric Portal Practice Clinic (PPPC) was opened on 1 September 2017. The PPPC represented a cross-sectoral healthcare model funded by the federal state and health insurance companies over a 6-year period. It served as a point of contact for parents who considered their child to need emergency or acute care. In addition to offering outpatient paediatric care (Monday to Friday, from 8 a.m. to 10 p.m.; on weekends from 10 a.m. to 10 p.m.), a few beds were reserved in the PPPC if, for example, it was considered it would be beneficial to monitor the course of the disease, but where monitoring was only expected to be needed until the following day. Seriously ill patients were immediately referred to other hospitals. ▶ **Fig. 1** shows the distribution of hospitals in the region. The closest hospital for basic and routine care (at 30 km away) is in Anklam, a town with a population of 13,000 [13]. The Department of Paediatrics in this town was closed on 1 January 2015, and then reopened on 1 February 2016. A third regional hospital (27 km away), a university hospital, can be found in the town of Greifswald (59,000 inhabitants) [13]. Since the region borders Poland and the Baltic Sea, only three other hospitals would be accessible for use, although these are located relatively far away (Stralsund = 73 km, Pasewalk = 82 km, and Neubrandenburg = 85 km).

Demand due to paediatric patients at the three hospitals (see ▶ **Fig. 1**) for the years 2015–2019 was investigated on the basis of the following objectives: (1) Determine trends in the number and average age of outpatient or inpatient patients; (2) Determine the effect due to the PPPC opening in the hospital after closure the paediatrics department and (3) Determine the influence due to the closure of the Department of Paediatrics in Wolgast, and the impact of the PPPC opening on the use of the rescue services in the region.

Methodology

The analysis includes patient data from the hospitals, including the PPPC (excluding births), for patients aged 18 years of age and younger, who were treated at least once during the observation period in one of the three hospitals, and for whom the patient address was in Wolgast or the surrounding area (operationalised as 12 postcode areas, see ▶ **Fig. 1**). The data we evaluated and collected in the controlling departments of the hospitals included the number of treatment cases by gender, age on admission day, post-

code from the patient address, admission and discharge dates, and the main diagnosis (ICD-10-GM 2019).

Further analysis was based on data from the regional rescue services for the 12 postcode areas of the region being investigated. The utilisation of rescue services (requests by emergency call to 112) for all patients under 18 years of age, the patient age, and the transport destination were evaluated.

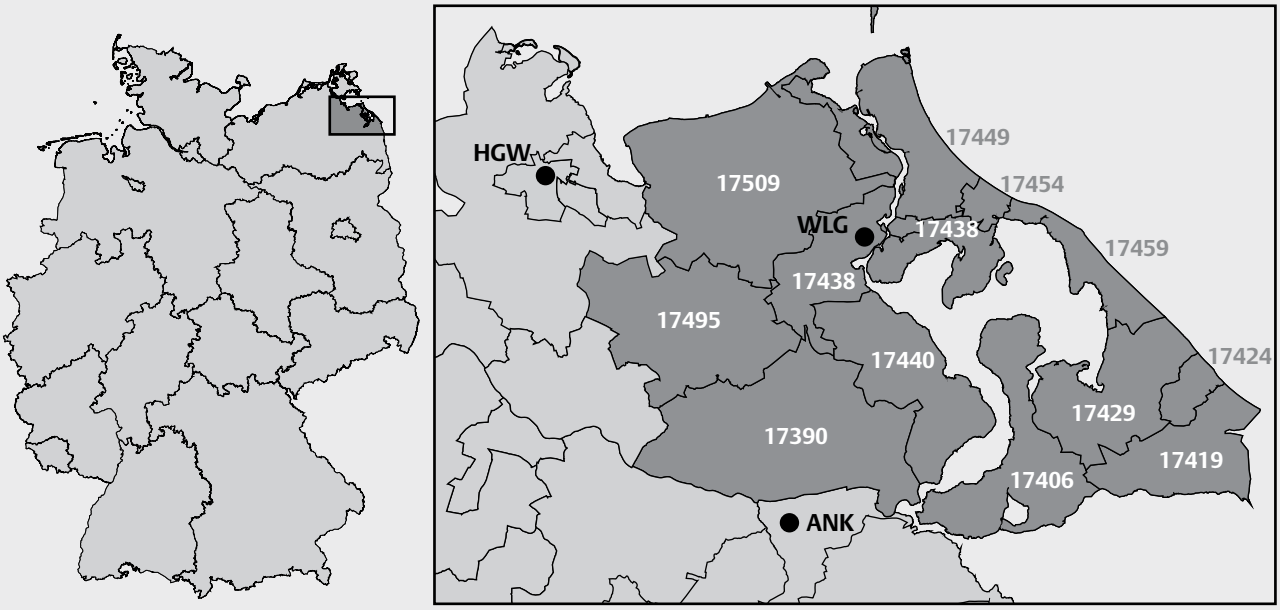
Statistics

The data were evaluated following a descriptive approach using the statistics program SAS (Version 9.4; SAS Institute, Cary, NC, USA). The age and duration of the hospital stay were calculated as a median value and the interquartile range (IQR). The data analysis followed the guidelines set down by "Good Epidemiological Practice" [14] and "Good Practice Secondary Data Analysis" [15].

Results

Number of cases

▶ **Tab. 1** shows the trends in cases overall, and for individual hospitals, per year. A total of 6,102 inpatient and 29,312 outpatient cases from the Wolgast region were documented over the observation period. In 2016 (closure of the Department of Paediatrics in Wolgast), all three hospitals recorded a 33 % reduction in the number of inpatients (2015: 1,787 cases; 2016: 1,193 cases). Over



▶ **Fig. 1** Analysed post-code areas (HGW = Greifswald; WLG = Wolgast; ANK = Anklam).

▶ **Tab. 1** Cases amongst under-18-year-old patients over the entire observation period (Wolgast region)

	Period	Number of cases (n)						Age (years)		Percentage female
		Total	2015	2016	2017	2018	2019	Mean value (SD):	Median (IQR)	Percent
Inpatient care										
Wolgast[a]	01.2015–12.2019	1,770	1,245	211	84	105	125	7.8 (5.9)	8.0 (2.0–14.0)	48.0 %
Anklam	02.2016–12.2019	1,047	0	207	278	282	280	5.6 (5.4)	3.5 (1.0–10.0)	51.3 %
Greifswald	01.2015–12.2019	3,285	542	775	702	666	600	6.7 (5.9)	5.0 (1.0–12.0)	46.3 %
Total		6,102	1,787	1,193	1,064	1,053	1,005			
Outpatient care										
Wolgast ED[a]	01.2015–12.2019	6,470	2,596	1,185	952	872	865	8.6 (5.3)	9.0 (4.0–13.0)	46.0 %
PPPC[b]	09.2017–12.2019	3,618	0	0	601	1,502	1,515	5.0 (4.7)	3.0 (1.0–8.0)	51.5 %
Anklam	01.2015–12.2019	1,748	187	346	376	418	421	6.3 (5.3)	5.0 (1.5–11.0)	48.9 %
Greifswald	01.2015–12.2019	17,476	3,467	4,067	3,779	3,194	2,969	7.1 (5.2)	6.0 (2.0–6.0)	47.1 %
Total		29,312	6,250	5,598	5,708	5,986	5,770			

[a] Inpatient and general admissions to the Emergency Department (from 01.02.2016, with no paediatric specialist);[b] Paediatric portal practice clinic (PPPC). SD = Standard deviation. IQR = Interquartile Range

the entire five-year period, the number of inpatient cases decreased by 44 % (2019: 1,005 cases). With regards to the number of inpatient cases in the individual hospitals, the following was found: in the Wolgast hospital, in 2016, there were 83 % fewer treatment cases during the year of closure as compared to the previous year (2015: 1,245 cases; 2016: 211 cases). In the Anklam hospital, cases increased in the first two years after the reopening of the Department of Paediatrics in Anklam (2016: 207 cases; 2017: 278 cases). In 2016, the number of cases at the hospital in Greifswald increased as compared to the previous year (2015: 542 cases; 2016: 775 cases), but subsequently decreased again. Overall, the number of cases increased by 11 % at the Greifswald Hospital (2015: 542 cases; 2019: 600 cases).

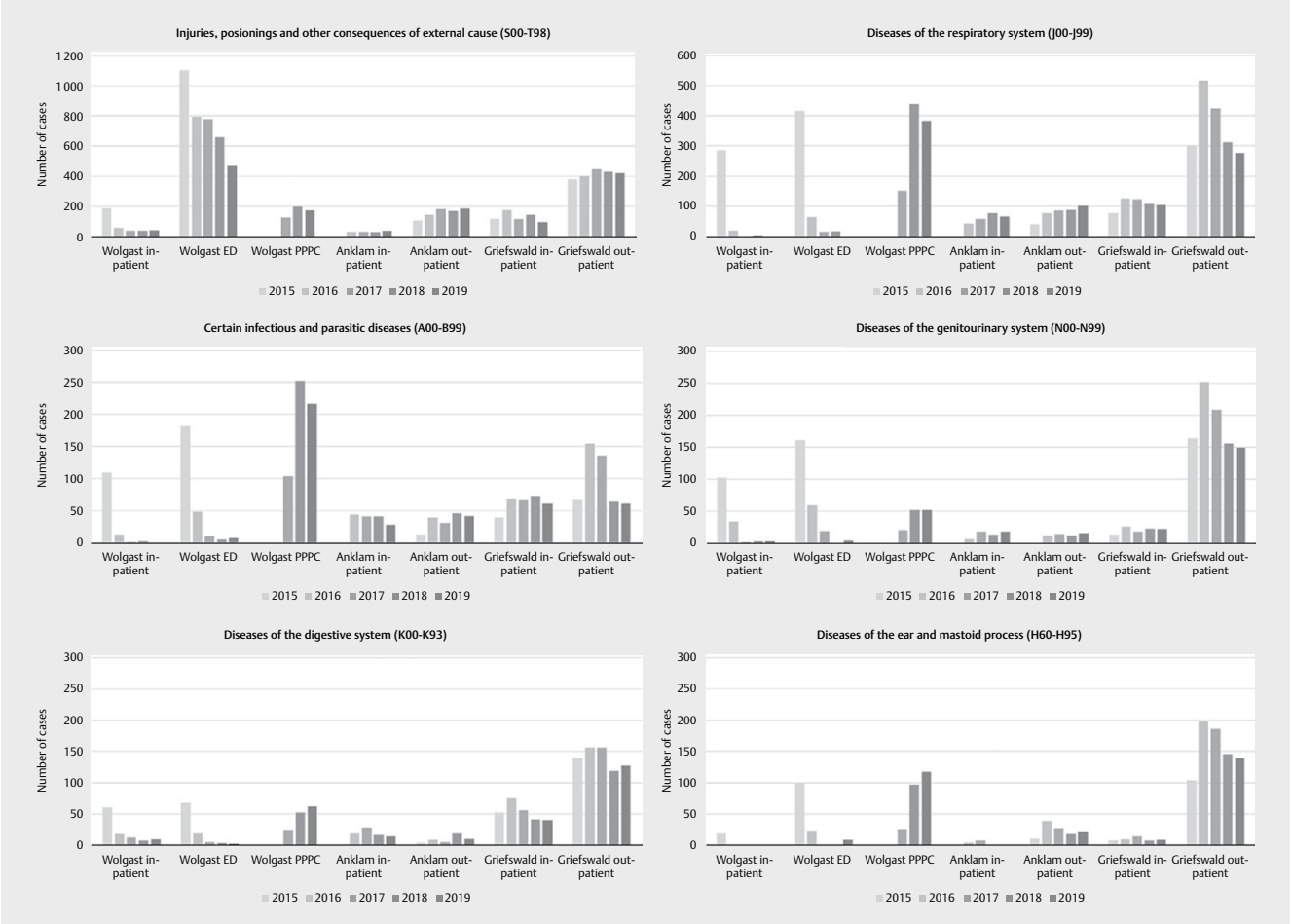
The total number of outpatient cases recorded at all three hospitals fell by 8 % (2015: 6,250 cases; 2019: 5,770 cases). In the year of the department's closure (2016), there were 1,411 fewer treatment cases at the Wolgast hospital as compared to the previous year (a 54 % reduction). Cases increased following the reopening of the Anklam hospital (2016: 346 cases; 2019: 421 cases). The number of cases at the hospital in Greifswald increased as compared to the previous year (2015: 3,467 cases; 2016: 4,067 cases).

With the opening of the PPPC in September 2017, the number of outpatient cases at the hospital in Wolgast increased once again. Since separate data were available from the hospital in Wolgast for the general (adult) emergency room and the PPPC, it was possible to determine that the number of paediatric treatment cases in the PPPC saw a substantial increase. At the same time, patients under 18 years of age began using the outpatient services of the hospital in Greifswald from 2017 onwards.

In 2015, hospitalised patients at Wolgast hospital were 5.0 years of age on average (median value); by 2019, the median age had risen to 13.0 years. Outpatient cases in 2019 at the Wolgast General Emergency Department were on average 11.0 years old (median value), and 3.0 years old at the PPPC.

ICD-10 Diagnostic Groups

▶ **Fig. 2** shows the trends for the number of outpatient and inpatient cases for the six most common diagnostic groups (ICD-10 chapters), which were documented over the observation period and for the observation region in the population aged less than 18 years of age. The reduction in inpatient case numbers is distributed across all six of the most common diagnostic groups. For the year of the department closure, the inpatient cases from Wolgast were initially shunted towards the two outpatient and inpatient services of the two neighbouring hospitals. Whilst the number of inpatient cases for the diagnoses of "Diseases of the digestive sys-



▶ **Fig. 2** Documented diagnoses (ICD-10 chapter) amongst under-18-year-old patients from the Wolgast region Key: ED = General Emergency Department (from 01.02.2016, with no paediatric expertise); PPPC = Paediatric Portal Practice Clinic.

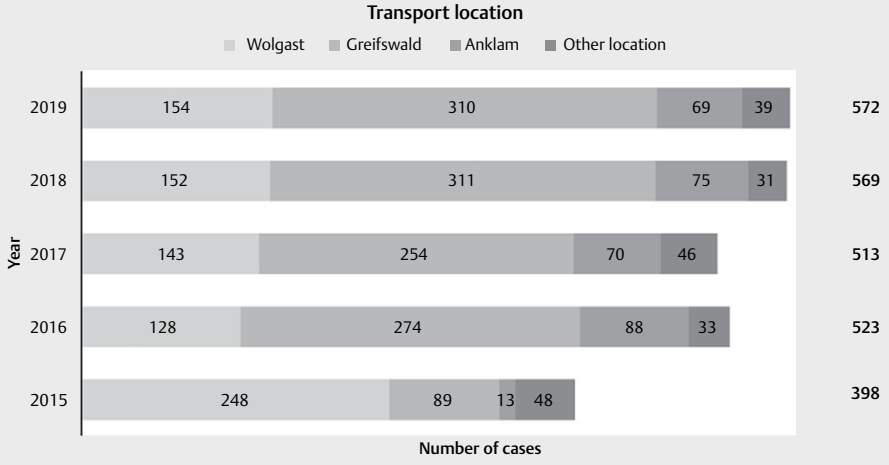
tem (K00-K93)", "Diseases of the genitourinary system (N00-N99)" and "Injuries, poisoning and other consequences of external causes (S00-T98)" decreased again in 2017, the number of cases in the outpatient services largely remained at an increased level. With the opening of the PPPC in the area of the previous department closure, cases were shunted back towards Wolgast.

With respect to outpatient cases, Wolgast (General Emergency Department and PPPC) was the most frequent cases in Wolgast of people under 18 years involved injuries, poisoning and other consequences of external causes (ICD S00-T98).

Regional rescue services

▶ **Fig. 3** shows the number of ambulance deployments in the region investigated, as well as the location where patients were transported to. A total of 2,575 ambulance deployments were documented for people under 18 years of age. In the year of the department's closure (2016), the most considerable change can be observed (2015: n = 398; 2016: n = 523; + 121 call-outs; + 31 %). The number of ambulance deployments continued to increase through to 2019 (2015: n = 398; 2019: n = 572; + 174 call-outs; + 44 %). There was a reduction in the number of people under the age of 18 who were transported by ambulance to the hospital in Wolgast, whilst from 2016 onwards, more patients under the age of 18 were taken to Greifswald and Anklam.

▶ **Tab. 2** shows the median age of all under-18-year-olds who were taken to one of the three hospitals by rescue services. In 2016, the median age of patients transported to Wolgast by rescue services increased; meanwhile, a reduction in the median age could be observed in the surrounding hospitals, whereby a considerable



▶ **Fig. 3** Trends in ambulance deployments over the observation period.

▶ **Tab. 2** Median age of under-18-year-old patients over the entire observation period (Wolgast region)

	Hospitals							Ambulance transport location		
Age (years) *	**Wolgast Inpatient[a]**	**Wolgast ED[a]**	**Wolgast PPPC[b]**	**Anklam Inpatient**	**Anklam Outpatient**	**Greifswald Inpatient**	**Greifswald Outpatient**	**Wolgast**	**Greifswald**	**Anklam**
2015	5.0 (1.0–10.0) *n = 1,245*	5.0 (2.0–11.0) *n = 2,595*			8.0 (3.0–12.0) *n = 187*	6.5 (0.0–13.0) *n = 542*	7.0 (2.0–12.0) *n = 3,467*	10.2 (3.0–14.5) *n = 248*	9.7 (3.6–15.6) *n = 89*	13.8 (6.7–15.4) *n = 13*
2016	13.0 (5.0–16.0) *n = 211*	10.0 (5.0–14.0) *n = 1,185*		4.0 (1.2–10.6) *n = 207*	5.0 (2.0–11.0) *n = 346*	6.0 (1.0–12.0) *n = 775*	6.0 (2.0–11.0) *n = 4,067*	13.2 (7.1–16.0) *n = 128*	7.8 (2.9–12.8) *n = 274*	7.1 (2.8–11.7) *n = 88*
2017	15.0 (14.0–17.0) *n = 84*	11.0 (7.0–14.0) *n = 952*	3.0 (1.0–7.0) *n = 601*	3.5 (1.0–10.2) *n = 278*	5.0 (1.0–10.0) *n = 376*	4.5 (1.0–12.0) *n = 702*	7.0 (2.0–12.0) *n = 3,779*	12.3 (6.2–15.2) *n = 143*	7.9 (2.4–13.3) *n = 254*	7.9 (2.3–13.5) *n = 70*
2018	15.0 (11.0–16.0) *n = 105*	10.0 (6.0–14.0) *n = 872*	3.0 (1.0–8.0) *n = 1,502*	4.3 (1.2–10.4) *n = 282*	5.0 (1.0–10.0) *n = 418*	6.0 (1.0–12.0) *n = 666*	7.0 (3.0–12.0) *n = 3,194*	11.5 (5.9–15.1) *n = 152*	5.9 (2.2–12.3) *n = 311*	6.2 (1.9–14.2) *n = 75*
2019	13.0 (9.0–15.0) *n = 125*	11.0 (6.0–15.0) *n = 865*	3.0 (1.0–7.0) *n = 1,515*	3.0 (1.1–9.4) *n = 280*	4.0 (2.0–11.0) *n = 421*	5.0 (1.0–13.0) *n = 600*	7.0 (3.0–12.0) *n = 2,969*	12.9 (7.9–15.5) *n = 154*	7.0 (2.4–13.7) *n = 310*	5.8 (2.3–13.6) *n = 69*

* Median (interquartile range). [a] Inpatient and general admissions to the Emergency Department (from 01.02.2016, with no paediatric specialist), [b] Paediatric portal practice clinic (from 01.09.2017)

increase in utilisation of rescue services could be observed over the same time period.

Discussion

The analysis showed a considerable change in the demand for inpatient paediatric services. The total number of inpatient cases in the region showed a substantial decrease, whilst the population numbers for the age groups concerned remained roughly the same [16]. Despite the closure of the paediatric department in Wolgast, 211 patients under the age of 18 were admitted to the hospital there - these were mostly school-age children. However, the question of whether care in a non-paediatric department is appropriate was not the subject of this investigation, and therefore cannot be addressed here.

It was shown that with the opening of the PPPC in Wolgast, many parents looked to services near their place of residence for acute health problems of their children. This shows clear effects in favour of locally-distributed care models. Cross-sector emergency and acute-care services for patients under 18 years of age was particularly sought out by parents with young children. The increasingly important role for hospitals in outpatient care also relates to periods outside normal office opening hours, offering a great potential for providing care. Hospitals benefit from the coordinating and filtering function offered by this provision of care services, taking the strain off emergency departments and/or leading to avoidance of hospitalisations that are not absolutely necessary – which is also required by Law [17].

The closure of the Department of Paediatrics in Wolgast led to more ambulance deployments, and a shift was seen in the transport destination towards Greifswald and Anklam. The increase in ambulance deployments suggests that parents are reluctant to go to emergency departments which are further away when this is needed; instead, they will call the rescue services. Considering the international context, studies have shown that up to 61 % of the rescue services are not medically indicated [18–21]. Specialist doctors in paediatrics and adolescent medicine highlight increased demand expressed across all social classes, and this is largely the result of increasing uncertainty amongst many parents in the face of their children's health issues [3, 22]. Reduced office opening hours and long travel distances to attend outpatient physician practices both lead to increased use of emergency departments [23, 24]. Further reasons for visiting emergency departments include the broad range of care expected to be available with specialist expertise from experienced paediatricians, as well as a lack of knowledge regarding alternative outpatient rescue services [25–27]. A question surrounding the definition of "appropriate care" has also arisen in the wake of this analysis. Distances travelled to seek out healthcare services are not quality indicators if they are considered in isolation, but when viewed in concert with social status they have been demonstrated to be relevant to care [28].

This analysis shows that gaps in care can be effectively remedied – in this case, by creating the PPPC service. In most cases, however, decisions for or against making closures are not based on data analysis in the region affected, but rather due to staffing or financial reasons. The definition of regional (or potentially cross-regional) quality indicators would provide an opportunity to create a basis for decision-making in this area.

To our knowledge, this is the first analysis of its kind in Germany, as analysis was carried out of data from several hospitals, including main diagnoses and data from the rescue services, for a defined investigation region and for patients under 18 years of age. For the first time, all the data could be analysed as a whole, with detailed analysis on the basis of five-digit postcodes over five consecutive calendar years.

We would like to highlight the following limitations: the data used were billing data from hospitals, which leads to limitations with regards to representing the entire care situation. Data on outpatient treatments provided by paediatricians or general practitioners were not available. It is therefore not clear whether there was any compensation for the lower-case numbers due to a shift towards privately-registered doctors. No reliable basic or diagnostic data were available for ambulance deployments, making it impossible to analyse the severity grade of presenting illnesses. It is also unclear how many of the children and young people transported by ambulance were actually living in the region, as the available data related only to the deployment locations, which do not always correspond with the patients' places of residence. Some of the postcode areas investigated are located in a holiday region receiving a large number of visitors with families. It can therefore be assumed that a certain proportion of the deployments would have concerned children on holiday, which may be the reason for a statistical overestimate being made of the number of rescue services in relation to the resident population. Furthermore, the analysis was concerned only with the use of services, but not the quality of care provided. Based on the available data, no changes in mortality or disease severity could be identified by the analysis. This would require the use of different data and instruments.

Key conclusions

The closure of the paediatrics department at a district hospital led to a considerable decrease in inpatient cases. This number of cases stabilised at this lower level over the observed time period. The number of outpatient cases in the hospitals of the region fell over the short term, but following the opening of a PPPC, these cases rose again to the levels seen before the closure. The number of regional rescue services increased, and stabilised at a higher level. In the future, innovative and cross-sectoral care concepts will be needed in order to ensure high-quality paediatric and regional care is provided over the long term. For this purpose, alternative care models should be examined in more detail before any uncoordinated dismantling of inpatient care services.

Conclusions for practice

Based on a case-number analysis, two inpatient departments can suffice for provision of paediatric care in one region. In any case, the focus should be on strengthening regional acute and emergency care, spanning as many sectors as possible. The innovation of a PPPC represents a possible model for doing so, which should be examined in more depth, and further developed.

Conflict of Interest

The authors declare that they have no conflict of interest.

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