

ORIGINAL RESEARCH

The Practice of Emergency Medicine

Projected Saudi Arabian pediatric emergency consultant physician staffing needs for 2021–2030

Areej Abudan MBBS, SB-Ped¹ | Olesya Baker PhD² | Amal Yousif MBBS³ | Roland C. Merchant MD, MPH⁴

¹ Saudi Ministry of Health, Riyadh, Saudi Arabia

² Center for Clinical Investigation, Brigham, and Women's Hospital, Boston, Massachusetts, USA

³ Ministry of National Guard, Riyadh, Saudi Arabia

⁴ Department of Emergency Medicine, Icahn School of Medicine at Mount Sinai, One Gustave L. Levy Place, New York, NY, USA

Correspondence

Roland C. Merchant, MD, MPH, Department of Emergency Medicine, Icahn School of Medicine at Mount Sinai, One Gustave L. Levy Place, New York, NY 10029, USA.

Email: roland.merchant@mountsinai.org

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Abstract

Background: Assess current and future pediatric emergency physician supply and need at 26 pediatric emergency departments (EDs) in 10 administrative regions across Saudi Arabia from 2021 through 2030.

Methods: For 10 administrative regions across Saudi Arabia, data were obtained on the size of the pediatric population (children <14 years old), the expected number of pediatric ED visits, and the number of pediatric emergency, fellowship-trained consultant physicians for the years 2015 through 2019. Time series linear regression modeling was used to estimate annual pediatric population sizes and pediatric ED visits for 2021–2030, based on 2015–2019 data trends. The projected number of pediatric emergency consultant physicians needed for 2021–2030 based on these trends was calculated according to a consensus method adopted by the Saudi Ministry of Health.

Results: For the 10 Saudi Arabian administrative regions, the pediatric population is estimated to be 8,061,409 (95% confidence interval [CI]: 7,815,767 to 8,307,052) in 2021 and 9,764,591 (95% CI: 9,046,490 to 10,500,000) for 2030, and estimated the number of pediatric ED visits is 3,442,259 (95% CI: 3,013,697 to 3,870,822) for 2021 and 4,610,072 (95% CI: 3,026,986 to 6,193,158) for 2030. The projected number of pediatric emergency consultant physicians needed for 2021 is 1158 (95% CI: 1,002 to 1,314) and for 2030 is 1500 (95% CI: 985 to 2016), whereas deficit in number of pediatric emergency consultant physicians available is 1107 (95% CI: 944 to 1,270) for 2021 and 1405 (95% CI: 869 to 1,941) for 2030.

Conclusions: The study projections demonstrate a disparity between current and projected supply and demand of pediatric emergency physicians within Saudi Arabia.

KEYWORDS

emergency medicine, emergency service, hospital, forecasting, health services research, pediatrics, pediatric emergency medicine, Saudi Arabia, workforce

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1 | INTRODUCTION

1.1 | Background

Pediatric emergency medicine is a relatively new subspecialty in Saudi Arabia. Becoming a pediatric emergency physician in Saudi Arabia requires completion of either a 4-year pediatric or an adult emergency medicine residency, followed by a 2-year pediatric emergency medicine fellowship program. Pediatric emergency medicine fellowship programs are overseen by the Saudi Commission for Health Specialties and train physicians in pediatric emergency care using the Canadian Medical Education Directives for Specialists (CAN Meds) framework.¹ There are 12 pediatric emergency medicine training centers in Saudi Arabia with a total capacity of 68 fellows distributed across 4 cities: Riyadh, Makkah, Jeddah, and Khams Mushiati.¹ After gaining 1 year of clinical practice experience in pediatric emergency medicine post fellowship, pediatric emergency physicians in Saudi Arabia can be licensed to be a pediatric emergency consultant physician (analogous to an attending physician) through the Saudi Commission for Health Specialties.² The pediatric emergency medicine fellowship training program pathway in Saudi Arabia began in 2005 and has grown over time with the aim of providing pediatric emergency fellowship-trained consultant physicians for the contemporaneously increasing number of dedicated pediatric emergency medicine facilities in the country.

Currently in Saudi Arabia, pediatric emergency medicine care is provided by fellowship-trained pediatric emergency physicians, general emergency physicians, and pediatricians. Although general emergency physicians and pediatricians provide high-quality care to pediatric patients, in contrast to fellowship-trained pediatric emergency physicians, general emergency physician trainees in Saudi Arabia are engaged in only 2 months of pediatric emergency medicine practice per year for each of their 4 years of training, plus a 2-month pediatric intensive care unit rotation. Pediatric emergency physicians who complete training in the specialty are particularly equipped to manage efficiently medical, surgical, and trauma pediatric cases, regardless of their severity and complexity. Moreover, they are skilled in and trained to lead an emergency department (ED), educate trainees, and conduct research that furthers the specialty. As such, it is beneficial to the health care system in Saudi Arabia to increase the supply of fellowship-trained pediatric emergency physicians.

1.2 | Importance

The Saudi Vision 2030 in the Healthcare Sector expressly addresses the need for further development of emergency medicine services, particularly for children.³ Moreover, it urges the provision of the highest quality of care in managing pediatric critical and emergency care. This focus on pediatric emergency care is timely, given the demography in Saudi Arabia and its growing pediatric population. The midyear 2019 population census in Saudi Arabia was 34,218,169; 25% of the population were children <14 years old (8,389,963).⁴ Given this large population coupled with 2.4% annual growth rate of the Saudi population,

The Bottom Line

The need for pediatric emergency care in Saudi Arabia is increasing rapidly. This study applied time series modeling to estimate the growth in pediatric emergency department visits through 2030. This was then compared with estimated growth of pediatric emergency physicians at current training rates, which showed a projected deficit of 1405 physicians by 2030.

demand for pediatric emergency care signifies an increasing requirement to meet expected need. Given the growing pediatric population in Saudi Arabia, if the current and future physician supply does not meet needs in Saudi Arabia, then the care of these patients might be adversely affected.

1.3 | Goals of this investigation

To address how Saudi Arabia should meet its upcoming need for pediatric emergency physicians, in this investigation we assess current and future pediatric emergency physician supply and need at 26 pediatric EDs in 10 administrative regions across Saudi Arabia from 2021 through 2030. We first estimate the size of the pediatric population (children <14 years old) and the expected number of pediatric ED visits across these 10 administrative regions. Using these data, we estimate the pediatric emergency consultant physician needs according to an international benchmark. We then project pediatric emergency consultant physician deficits at these facilities through 2030 per current estimates of pediatric pediatric emergency medicine fellowship graduates.

2 | METHODS

2.1 | Study design and setting

This investigation was a secondary analysis of administrative data. The setting for this investigation was the Kingdom of Saudi Arabia. Saudi Arabia is divided into 13 administrative regions, which include 46 cities, of which 20 are major cities. Each administrative region contains provinces that differ in number across regions.⁵ Across these regions, the Saudi Ministry of Health supervises 20 General Directorates of Health Affairs, 5 medical cities (2 of which are under development), and 5 medical clusters.^{6,7} For this investigation, we had access to data for 10 of the 13 Saudi Arabian administrative regions (Riyadh, Makkah, Eastern, Madinah, Al Baha, Al Jawf, Qassim, Ha'il, Tabuk, and Aseer). For these 10 regions, we included Ministry of Health hospitals with capacities of 100 beds or greater that had pediatric EDs. In these 10 regions, there are 66 hospitals, 53 general hospitals, and 13

maternity and children's hospitals. The [supplemental figure](#) provides a map of these regions and hospitals.

Of note, pediatric EDs in Saudi Arabia serve patients 14 years old and younger; hence this study did not include older adolescents. In rural regions of Saudi Arabia where pediatric EDs are not available, patients 14 years old and younger receive care in general EDs, but in separate sections reserved for this age group. Otherwise, patients 14 years old and older receive care in adult EDs. Excluded in this study were psychiatry and mental health hospitals, hospitals smaller than a 100-bed capacity, and facilities without a pediatric ED. Of the 26 Saudi Arabian Ministry of Health hospitals in the 10 administrative regions with pediatric EDs included in this investigation, 14 are maternity and child hospitals, 1 is a tertiary care hospital, and 11 are community hospitals. The study was entirely based on registry data and approved by the Saudi Ministry of Health (central IRB log No:2019-0175 M), and approved by each region's director and respective regional study and research departments.

2.2 | Data sources

Data on ED visits and pediatric emergency consultant physician staffing were obtained from the director of each of the 26 pediatric EDs. Before 2018, pediatric ED census data were collected manually daily by pediatric ED nursing staff and submitted monthly to the hospital's nursing director, who released it for processing by the hospital's statistics department. After 2018, these data were collected using electronic health record data. The Saudi General Authority for Statistics provided detailed population data, and the Saudi Commission for Health Specialties provided data on the annual number of pediatric emergency physician fellowship graduates.

2.3 | Outcomes

The primary outcome for this investigation was the projected number of pediatric emergency consultant physicians needed in the 10 regions of Saudi Arabia included in this study for 2021 through 2030, as well as the projected deficits in pediatric emergency consultant physicians for this time period. For the purposes of this investigation, pediatric emergency consultant physicians were defined as pediatric emergency fellowship-trained physicians rather than general emergency medicine physicians or pediatricians. Secondary outcomes that enabled calculation of the primary outcome were estimates of the projected number of children < 14 years old living in the 10 regions of Saudi Arabia and the number of pediatric ED visits during this time period.

2.4 | Analysis

Data analyses consisted of the following components. The population of children < 14 years old living in the 10 regions that form the catch-

ment areas of the 26 pediatric EDs was estimated using actual 2015–2019 population data for these regions. Time series linear regression modeling was used to project annual population sizes along with 95% confidence intervals (CIs) for the years 2021 through 2030 based on 2015–2019 population data trends. Lower and higher estimates for population sizes for these same years were calculated using 1 SD below and above estimated population growth, respectively. Pediatric ED visits for 2021 through 2030 for these same 10 regions were estimated using pediatric ED visits from 2015 through 2019 using similar methods.

Estimation of projected pediatric emergency consultant physician need for 2021 through 2030 was calculated according to a consensus method adopted by the Saudi Ministry of Health.⁸ Per this methodology, consultant need is based on the number of physician hours required to manage 2.5 patients/hour (total physician hours required = patient census/2.5 patients evaluated/hour/physician). For example, at a pediatric ED with census of 50,000 patients/year, 20,000 hours of pediatric emergency consultant physician time are required. If a full-time pediatric emergency consultant physician works 16 eight-hour shifts/month, and the annual full-time equivalent (FTE) of clinical hours is estimated as the number of shifts worked/month × number of hours worked/shift × 12 months × 80% (20% reduction for vacation time, training, other benefit time), then the number of physician hours that could be supplied by 1 physician is 16 shifts/month × 8 hours/shift × 12 months × 0.8 = 1228.8 hours/year. For a 50,000 pediatric ED, the number of FTE pediatric emergency consultant physicians to manage 2.5 patients/hour is 50,000 patients/year/2.5 patients/hour/pediatric emergency physician clinical hours/year = 50,000/2.5/1228.8 = 16.27 (≈17 pediatric emergency consultant physician FTEs/year needed). Using this methodology, the number of pediatric emergency consultant physicians needed to meet pediatric ED volume was calculated based on the estimated number of pediatric ED visits for 2021 through 2030. In a similar manner as described previously for pediatric population and pediatric ED visits, linear regression modeling was employed to create estimates of pediatric emergency consultant physicians needed over the 10-year period, along with corresponding 95% CIs and estimates 1 SD above and below these estimates.

Calculation of the deficit in the annual number of pediatric emergency consultant physicians needed from 2021 through 2030 was based on the following assumptions: (1) pediatric emergency consultant physicians practicing in 2019 will continue to work in the 26 pediatric EDs during 2021 through 2030, (2) the number of pediatric emergency medicine fellowship trainees graduating/year will remain at the 2019 level, and (3) all pediatric emergency medicine fellowship trainees will work as consultants in the 26 pediatric EDs located in the 10 Saudi Arabian regions. The deficit per year in pediatric emergency consultant physicians was estimated as the estimated number of pediatric emergency consultant physicians needed annually minus the expected number of consultants available for that year. Similar methods were used to create estimates 1 SD above and below these expected numbers along with corresponding 95% CIs.

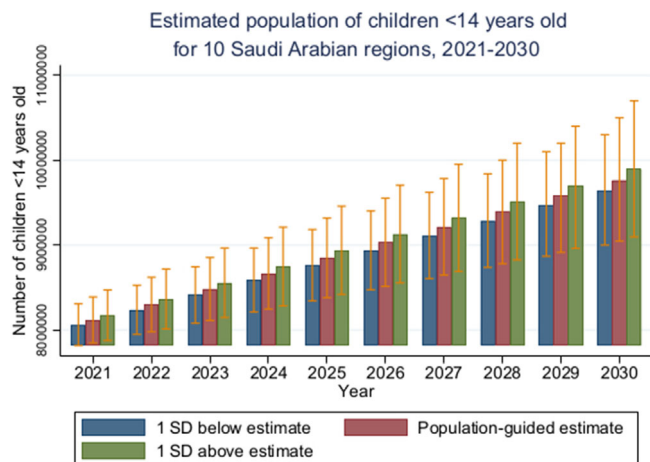


FIGURE 1 Estimated population for children <14 years old for 10 Saudi Arabian regions, 2021–2030

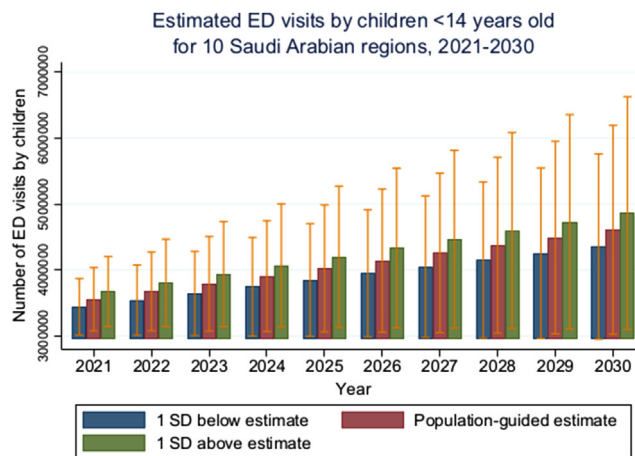


FIGURE 2 Estimated emergency department visits by <14 years old for 10 Saudi Arabian regions, 2021–2030

3 | RESULTS

3.1 | Projected number of children ≤ 14 years old living in 10 Saudi administrative regions, 2021–2030

Based on 2015–2019 census data, linear regression modeling estimated a yearly increase of 183,157/children/year (or about a 2.52%/year increase) over this 5-year historical period. Applying this rate of growth, the projected population of children < 14 years old living in the 10 regions during 2021 is 8,061,409 and for 2030 is 9,764,591 (Table 1). Figure 1 shows the projected population of children < 14 years old for the 10 Saudi administrative regions from 2021 through 2030.

3.2 | Projected number of pediatric ED visits in 10 Saudi administrative regions, 2021–2030

Using the 2015–2019 pediatric ED visit data for the 26 pediatric EDs in the 10 Saudi administrative regions, linear regression modeling estimated a yearly increase of 116,947/pediatric ED visits/year (or about a 3.99%/year increase) over this 5-year historical time. Applying this rate of growth, pediatric ED visits projected for 2021 are 3,442,259 and for 2030 are 4,610,072 (Table 1). Figure 2 shows the estimated visits for the 26 pediatric EDs in the 10 administrative Saudi regions from 2021 through 2030.

3.3 | Projected pediatric emergency consultant physicians needed for 10 Saudi administrative regions, 2021–2030

Using the Saudi Ministry of Health consensus method⁸ for pediatric emergency medicine consultant physicians needed to meet pediatric ED patient volume from 2021 through 2030, linear regression

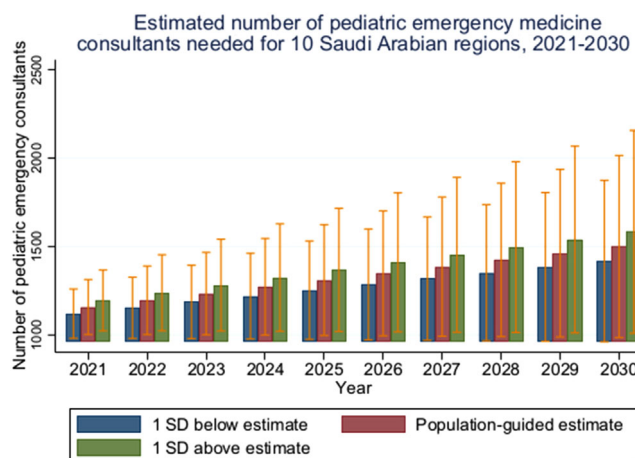


FIGURE 3 Estimated number of pediatric emergency medicine consultants needed for 10 Saudi Arabian regions, 2021–2030

modeling estimated an increase of 43 consultants/year (or about a 3.99%/year increase). Table 1 depicts how projected pediatric emergency consultant physician need increases from 2021 to 2030 (1158–1500). Figure 3 shows the projected pediatric emergency consultant physician need for the 10 Saudi administrative regions from 2021 through 2030.

3.4 | Projected deficits in pediatric emergency consultant physicians for 10 Saudi administrative regions, 2021–2030

Figure 4 displays the projected deficits by year in the number of pediatric emergency consultant physicians as a function of need estimated by pediatric ED volume. The projected annual deficits assume that pediatric emergency consultant physicians practicing in 2019 (1020) will continue to work in pediatric EDs during 2021 through 2030, the number of pediatric emergency medicine fellowship trainees

TABLE 1 Projections by year for population of children <14 years old, pediatric emergency department visits by children < 14 years old, pediatric emergency physician consultants needed, and pediatric emergency physician consultants deficits, 2021–2030

Year	Population of children < 14 years old			Pediatric ED visits by Children < 14 years old			Pediatric emergency physician consultants needed			Pediatric emergency physician consultants deficits		
	Estimate	Lower 95%CI	Upper 95%CI	Estimate	Lower 95%CI	Upper 95%CI	Estimate	Lower 95% CI	Upper 95% CI	Estimate	Lower 95% CI	Upper 95% CI
Projections based on 1 SD below population-based estimates												
2021	8061409	7815767	8307052	3442259	3013697	3870822	1121	981	1260	1044	1029	1058
2022	8236689	7947612	8525765	3543804	3011440	4076169	1154	980	1327	1061	1042	1080
2023	8411968	8079320	8744615	3645349	3006705	4283993	1187	979	1395	1078	1049	1108
2024	8587247	8210939	8963555	3746894	3000550	4493238	1220	977	1463	1096	1054	1138
2025	8762526	8342496	9182556	3848439	2993511	4703366	1253	974	1531	1113	1058	1168
2026	8937805	8474010	9401601	3949983	2985888	4914079	1286	972	1600	1131	1062	1199
2027	9113084	8605490	9620678	4051528	2977858	5125198	1319	969	1668	1148	1067	1229
2028	9288363	8736946	9839780	4153073	2969534	5336612	1352	967	1737	1165	1071	1260
2029	9463643	8868383	10100000	4254618	2960992	5548244	1385	964	1806	1183	1075	1291
2030	9638922	8999804	10300000	4356163	2952282	5760043	1418	961	1875	1200	1079	1322
Projections based on population-based estimates												
2021	8116183	7844213	8388152	3557542	3078511	4036573	1158	1002	1314	1051	1034	1068
2022	8299339	7978157	8620521	3674490	3077608	4271373	1196	1002	1390	1071	1048	1094
2023	8482496	8111929	8853062	3791438	3074076	4508800	1234	1001	1468	1091	1056	1126
2024	8665652	8245588	9085716	3908385	3069046	4747725	1272	999	1545	1111	1061	1161
2025	8848809	8379170	9318447	4025333	3063089	4987577	1310	997	1624	1131	1066	1196
2026	9031965	8512698	9551232	4142281	3056519	5228043	1348	995	1702	1151	1070	1232
2027	9215122	8646186	9784057	4259229	3049523	5468934	1386	993	1780	1171	1074	1268
2028	9398278	8779643	10000000	4376176	3042221	5710132	1425	990	1859	1191	1078	1304
2029	9581435	8913076	10200000	4493124	3034690	5951558	1463	988	1937	1211	1083	1339
2030	9764591	9046490	10500000	4610072	3026986	6193158	1501	985	2016	1231	1087	1375
Projections based on 1 SD above population-based estimates												
2021	8172464	7874365	8470562	3672825	3142666	4202985	1196	1023	1368	1055	1026	1085
2022	8363780	8010506	8717055	3805176	3143062	4467290	1239	1023	1454	1087	1047	1127
2023	8555097	8146421	8963773	3937527	3140673	4734381	1282	1022	1541	1119	1056	1181
2024	8746414	8282191	9210636	4069877	3136703	5003051	1325	1021	1629	1150	1062	1238
2025	8937730	8417863	9457598	4202228	3131757	5272698	1368	1019	1716	1182	1067	1297
2026	9129047	8553464	9704630	4334578	3126168	5542989	1411	1018	1804	1213	1071	1356
2027	9320364	8689014	9951713	4466929	3120132	5813726	1454	1016	1892	1245	1075	1415
2028	9511680	8824526	10200000	4599280	3113775	6084785	1497	1014	1981	1277	1079	1475
2029	9702997	8960007	10400000	4731630	3107179	6356082	1540	1011	2069	1308	1082	1534
2030	9894313	9095464	10700000	4863981	3100400	6627562	1583	1009	2157	1340	1086	1594

Abbreviations: CI, confidence interval; ED, emergency department.

graduating/year remains at the 2019 level (33/year), and all pediatric emergency medicine fellowship trainees work as a consultant in the 26 pediatric EDs located in the 10 Saudi Arabian regions. Per these assumptions, linear regression modeling estimates an increase in the deficit of 33 consultants/year (or $\approx 3.59\%$ /year). This growth rate projects a deficit of 1107 pediatric emergency consultant physicians in 2021 and 1405 for 2030 (Table 1).

4 | LIMITATIONS

The primary limitation of this type study is the inherent assumptions of the projection models. Our models assume linear trends over time, that previous trends can assist in the prediction of future trends, and that demographic composition will remain stable (eg, the population of children < 14 years old in Saudi Arabia will not increase or

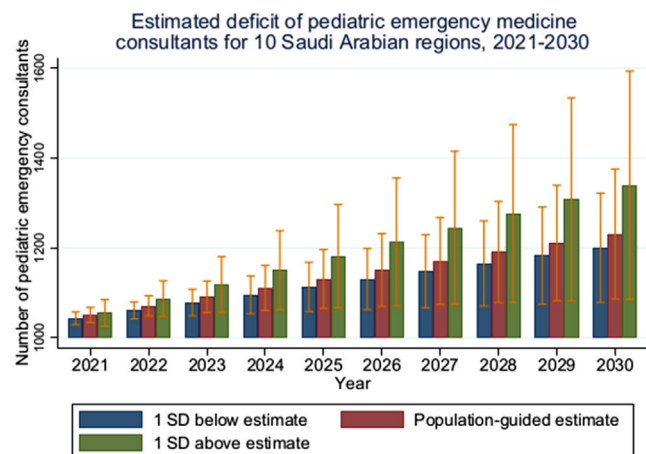


FIGURE 4 Estimated deficit of pediatric emergency medicine consultants for 10 Saudi Arabian regions, 2021–2030

decrease markedly). In addition, the models are dependent on other data points and model input assumptions. For example, immigration of pediatric emergency physicians, although unlikely, attrition of current pediatric emergency physicians (eg, retirement, career changes), or changes to pediatric emergency medicine training program graduation rates would affect these inputs. In addition, data before electronic processes might be less robust or be lower than actual counts. Further, differences across time in measuring pediatric ED visits, particularly before electronic processes were available, could have affected data points. As such, our findings are dependent on these assumptions, which, although reasonable for a short-term projection, could be incorrect. Further, although offering figures 1 SD below and above our estimates has value for addressing assumptions on the magnitude of our projections, they also reflect the assumption of linear trends and stable demography. Even though the calculations for need of pediatric emergency consultant physicians according to pediatric ED patient volume is supported by a consensus method adopted by the Saudi Ministry of Health, other methods might produce different estimates.⁸ As expected, the findings from this investigation might not reflect projections for the 3 regions of Saudi Arabia not included in these analyses (the Northern border, Jazan, and Najran), and the methodology used might not be applicable to other health care systems. Furthermore, as additional hospitals in Saudi Arabia establish pediatric EDs, there will be a greater need for physicians trained in pediatric emergency medicine; hence, the total number of physicians trained in pediatric emergency medicine across the nation is naturally higher than the estimates we offer in this investigation.

5 | DISCUSSION

The principal products of this investigation are estimates of the projected number of pediatric ED visits by children <14 years old expected to receive care at the current 26 pediatric EDs across 10 administrative regions in Saudi Arabia from 2021 through 2030, as well as

the estimated deficits in pediatric emergency consultant physicians as compared to need over this time period. If current trends from 2015 through 2019 hold, these 10 regions can expect that $\approx 4,610,072$ additional children will seek care in these EDs from 2021 through 2030. However, if current pediatric emergency medicine fellowship rates are maintained, there will be only 378 pediatric emergency consultant physicians available to provide care to these children by 2030, although 1404 actually are needed to meet this demand (a deficit of 1026 pediatric emergency consultant physicians). Inherent in these calculations are a demonstrable deficit in pediatric emergency consultant physicians that exists currently, and if changes are not made, will continue and perhaps worsen, depending on assumptions inherent in our models. The challenge of filling the need for pediatric emergency consultant physicians is even more severe in rural, non-urban areas of Saudi Arabia, because new pediatric emergency consultant physicians preferentially obtain positions in urban, academic pediatric EDs rather than non-academic, community, non-urban EDs.

There are several options available to fill the gap between supply and demand for pediatric emergency consultant physicians in these 10 administrative regions and likewise elsewhere in Saudi Arabia and areas in the world facing similar shortages. First, the number of pediatric emergency medicine fellowship positions in Saudi Arabia could be increased; however, capacity is based not only on resources available but also the number of academicians who can provide training to fellows. Except for recruiting consultants from outside of Saudi Arabia who are qualified to train fellows, training capacity will increase slowly over time. Second, as just suggested, fully trained pediatric emergency consultant physicians could be hired from elsewhere around the world, but such recruitment is challenging and other areas of the world also are facing shortages.^{9,10}

Third, non-pediatric emergency trained consultant physicians (eg, adult emergency medicine physicians, pediatricians) could provide care in pediatric EDs. However, they do not have the same training background and experience as fellowship-trained pediatric emergency physicians. There is only indirect rather than head-to-head direct comparison research assessing clinical outcomes between fellowship-trained pediatric emergency and non-emergency or general emergency physicians. Survey-based research have reported differences in comfort and self-assessed skills between pediatric emergency physicians and general emergency physicians. Jain et al. surveyed 375 physicians working in non-pediatric EDs and found that 57% were not comfortable examining, diagnosing, or treating pediatric patients, particularly younger children and those critically ill.¹¹ Goldman et al.'s mixed-methods study of community ED staff (physicians, nurses, nursing assistants) indicated discomfort with management of pediatric resuscitation, given its infrequency in the EDs where they practice.¹² In an International survey of senior emergency physicians working in 96 EDs affiliated with the Pediatric Emergency Research Networks, those working exclusively in pediatric emergency medicine practice (whether or not fellowship trained in pediatric emergency medicine), were more likely to report more experience in critical care procedures (eg, cardiopulmonary resuscitation, cardioversion, needle thoracocentesis).¹³ Auerbach et al. observed that quality of simulated resuscitative care of

infant sepsis, infant seizure, and child cardiac arrest was greater among EDs, pediatric or general, that had more pediatric patient visits.¹⁴ However, in another simulation study of child cardiac arrest, the relationship of greater ED patient volume to pediatric cardiac arrest guidelines was not clear.¹⁵ In regard to research examining actual rather than simulated outcomes, Nationwide Emergency Department Sample data from 2009–2014 observed that survival from non-traumatic out-of-hospital cardiac arrest was higher in pediatric than general EDs in the United States (33.8% vs 18.9%) but similar for traumatic out-of-hospital cardiac arrest.¹⁶ Among 426 hospitals in 5 states evaluated according to the 2013 National Pediatric Readiness Project (NPRP) assessment, Ames et al. found that critically ill patients < 18 years-old presenting to EDs at hospitals with higher NPRP scores in the United States were more likely to survive to hospital discharge.¹⁷ Lower NPRP score hospitals were less likely to have a dedicated pediatric ED. At Tufts Medical Center's pediatric ED from 2007–2010, Weiner et al. found that pediatric emergency physicians were less likely to order laboratory tests and medications and had faster patient throughput times than general emergency physicians.¹⁸ Singer et al. noted that after opening of a dedicated pediatric ED at Stony Brook Medical Center staffed by pediatric emergency physicians, there were decreases in ED length-of-stay and left-without-being-seen rates, fewer radiographic and laboratory tests ordered, and higher patient satisfaction scores.¹⁹ However, in Chime et al.'s scoping review of 19 published studies comparing care provided in general versus pediatric EDs for fever, croup, bronchiolitis, asthma, urticaria, febrile seizures, and diabetic ketoacidosis, the study authors noted a dearth of high-quality studies, which prevented definitive comparisons.²⁰

Fourth, the time spent to become a pediatric emergency consultant physician, which is about 6 years currently in Saudi Arabia, is another challenge. In comparison, becoming an adult emergency physician in Saudi Arabia requires only 4 years of training. The training period for pediatric emergency physicians in Saudi Arabia could be efficiently reduced to 4 years by establishing a high-quality curriculum covering all aspects of pediatric emergency medicine, which could reduce the timeline in producing highly qualified pediatric emergency consultant physicians. A fifth possibility is to move from a traditional pediatric ED staffing model solely with physicians to that of physicians supported by advanced practice providers (APPs). APPs (nurse practitioners or physician assistants) are a growing health care standard in the United States.²¹ Although in Saudi Arabia there is a 2-year diploma program in an adult emergency medicine offered through the Saudi Commission of Health Specialties for nurses, there currently is no similar program for pediatric emergency medicine.²² A viable opportunity exists to establish a pathway in Saudi Arabia for APPs (training, recruitment, investment) through existing programs to augment pediatric emergency care, particularly for regions with a high demand for pediatric ED visits.²³ Sixth, graduate medical education could attempt to address knowledge and training needs for general emergency and pediatrician trainees, such as increasing training periods in pediatric emergency medicine. In addition, continuing medical education on pediatric emergency medicine might help deficits in knowledge and practice experience. Finally, increasing availability of access to pediatric and general

medical practice could help reduce burden on Saudi Arabian pediatric EDs, as they might elsewhere globally.

In conclusion, pediatric emergency medicine in Saudi Arabia is a fast-growing field, but demand for services is growing faster than supply of pediatric emergency consultant physicians. The study projections demonstrate a disparity between current and projected supply of and demand for pediatric emergency consultant physicians within Saudi Arabia. They indicate the need to enact plans to address this critical need, including expanding training capacity for pediatric emergency physicians, modifying the training pathway for pediatric emergency physicians, or establishing non-physician training models.

CONFLICT OF INTEREST

The authors report no conflict of interest.

FUNDING INFORMATION

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AUTHOR CONTRIBUTIONS

Areej Abudan conceived of this project, assisted in the data analysis, and composed the initial draft of the manuscript. Olesya Baker conducted the analyses and assisted with the preparation of the manuscript. Amal Yousif assisted in obtaining the necessary data for the project and with the preparation of the manuscript. Roland C. Merchant assisted in the study design, analysis, and preparation of the manuscript. All authors read and approved the final manuscript.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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