An Approach to Consolidating Pediatric Hospital Beds During the COVID-19 Surge

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An Approach to Consolidating Pediatric Hospital Beds During the COVID-19 Surge

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Abbreviations:

HRR	Hospital Referral Region
HSA	Hospital Service Areas
PICU	Pediatric Intensive Care Unit

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Dr. França and Dr. McManus conceptualized and designed the study, drafted the manuscript, carried out the analyses, reviewed and revised the manuscript, and approved the final manuscript as submitted.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work. All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

INTRODUCTION

On April 3, 2020, in response to the COVID-19 pandemic, the Children's Hospital Association of the United States issued guidance for coordinating pediatric hospital care and increasing general hospital surge capacity.[1] Observing that approximately 200 hospitals already care for 50% of all pediatric admissions, it called for immediate consolidation of pediatric care within experienced pediatric facilities and coordinated efforts between children's and community hospitals to benefit both adult and pediatric patients. The goal was to expand adult capacity in community hospitals caring for older patients while, at the same time, providing care for pediatric patients in settings where customized pediatric resources are available. Mindful that local conditions vary, flexibility and thoughtful coordination across hospital systems were advised. Here we estimate hospital bed capacity under potential consolidation and the corresponding impact on patient travel distance.

METHODS

We used data from the 2018 American Hospital Association Annual Survey Database[2] to quantify the availability of pediatric hospital beds within the continental United States. Ratios of beds per thousand children (<18 years-old) were calculated using population data from the US Census[3]. We excluded psychiatric, chemical-dependence, and neonatal beds. We report descriptive statistics and/or numbers for state, Hospital Service Areas, and Hospital Referral Regions[4]. Distance from the centroid of counties to hospitals were estimated using the Haversine formula[5]. All analyses were conducted using Jupyter notebooks and Python 3.7. Interactive visualizations, available at https://bit.ly/ped_beds_covid, were produced with Plotly.

RESULTS

From a universe of 6,218 institutions, 3,547 general hospitals with functioning emergency departments were identified. Of these, 3,524 were located within the continental United States and 1,193 maintained a total of 30,798 pediatric beds. Only 52 institutions were characterized as exclusively pediatric (9,904 beds, 32.2% of total US pediatric capacity) but 319 were sufficiently specialized to require pediatric intensive care units (PICUs). These were distributed more widely and housed 23,085 beds, or 74.9% of total US pediatric inpatient capacity.

The distribution of all pediatric beds and of those in hospitals with PICUs is shown in Figure 1. The statewide fraction of pediatric beds contained in hospitals with PICUs ranged from 100% in Washington, DC to 0% in Wyoming (median 72.1%, IQR: 61.0%-82.4%). Median distances from county centroids to the nearest pediatric bed increased from 24.4 miles (IQR 13.7-37.2) under baseline conditions to 52.3 miles (IQR 31.9-77.7 miles) with diversion to PICU hospitals.

Populational distance estimates based on county census data are presented in Figure 2.

Notably, 93.2% of HSAs and 39.8% of HRRs did not contain a PICU. In the few regions with multiple PICUs (examples: Baltimore, Boston, Chicago, El Paso, Ft. Lauderdale, Houston, Indianapolis, and Los Angeles) additional consolidation could be undertaken with little impact on travel distance.

DISCUSSION

Decades of pediatric hospital care consolidation has left a system that is highly dependent upon a subset of specialized centers.[6,7] In a pandemic that preferentially spares children[8], this provides an opportunity for those centers to assume the entire burden of pediatric inpatient care. Here we show that roughly three-quarters of all pediatric beds are currently maintained in centers with PICUs, so the remaining capacity could theoretically be accommodated if a corresponding volume of non-emergent caseload is deferred.

Because previous estimates suggest that at least one in five admissions to children's hospitals can be considered "elective" and that admissions to general hospitals tend to have shorter lengths of stay[9], such accommodation may be achievable. However, as acknowledged by the Children's Hospital Association[1], the degree to which this can be practically implemented will depend on many factors including local practice characteristics, operating guidelines, transport systems, and COVID-19 patient surge conditions. In addition, our analysis suggests that the immediate cost of such a strategy is, on average, a doubling of travel distances for families seeking urgent or emergent pediatric care. Additional costs from delayed care and financial dislocations will depend upon the duration of the disruption and the extent to which "elective" pediatric medical and surgical care can be deferred. General pediatricians must be prepared to monitor and manage patients whose care has been delayed and to continue this through an extended period of backlog management. When the pandemic has passed, hospital administrators must be encouraged to reopen community pediatric services amidst the related financial pressures.[10]

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Figure Legends

Figure 1: Geographic distribution of pediatric hospital beds within the continental United States. States (excluding the District of Columbia) are shaded by the number of beds per thousand children (< 18 years) and the locations of hospitals are shown as black points. Because points may overlap, zoomable interactive figures are available at: https://bit.ly/ped_beds_covid. **Panel A**: All hospitals. **Panel B**: Hospitals with PICUs.

Figure 2: Populational estimates of distance pediatric hospitals.

Figure 1A. Pediatric Beds - All Hospitals

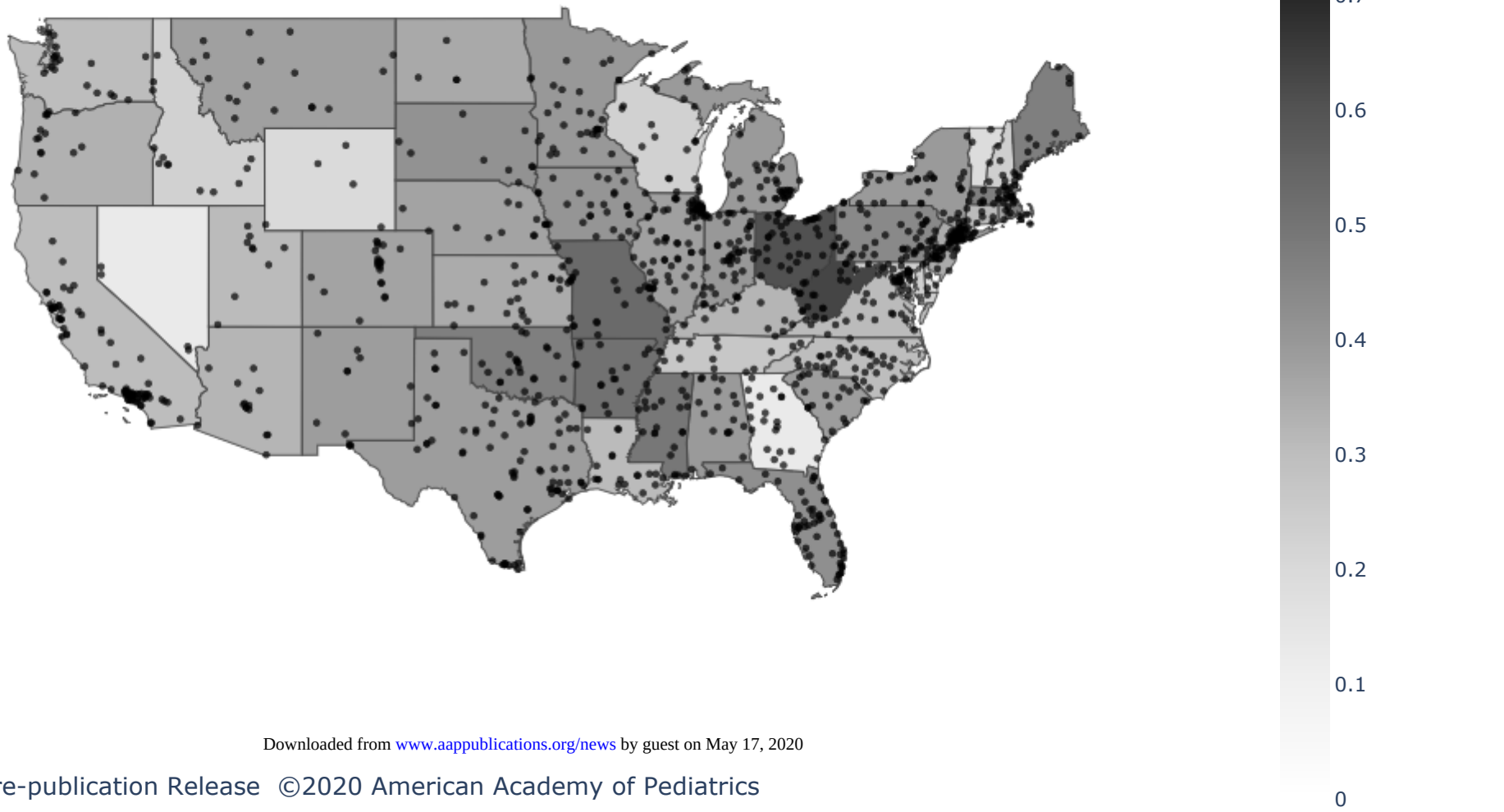


Figure 1B. Pediatric Beds - Hospitals with PICU

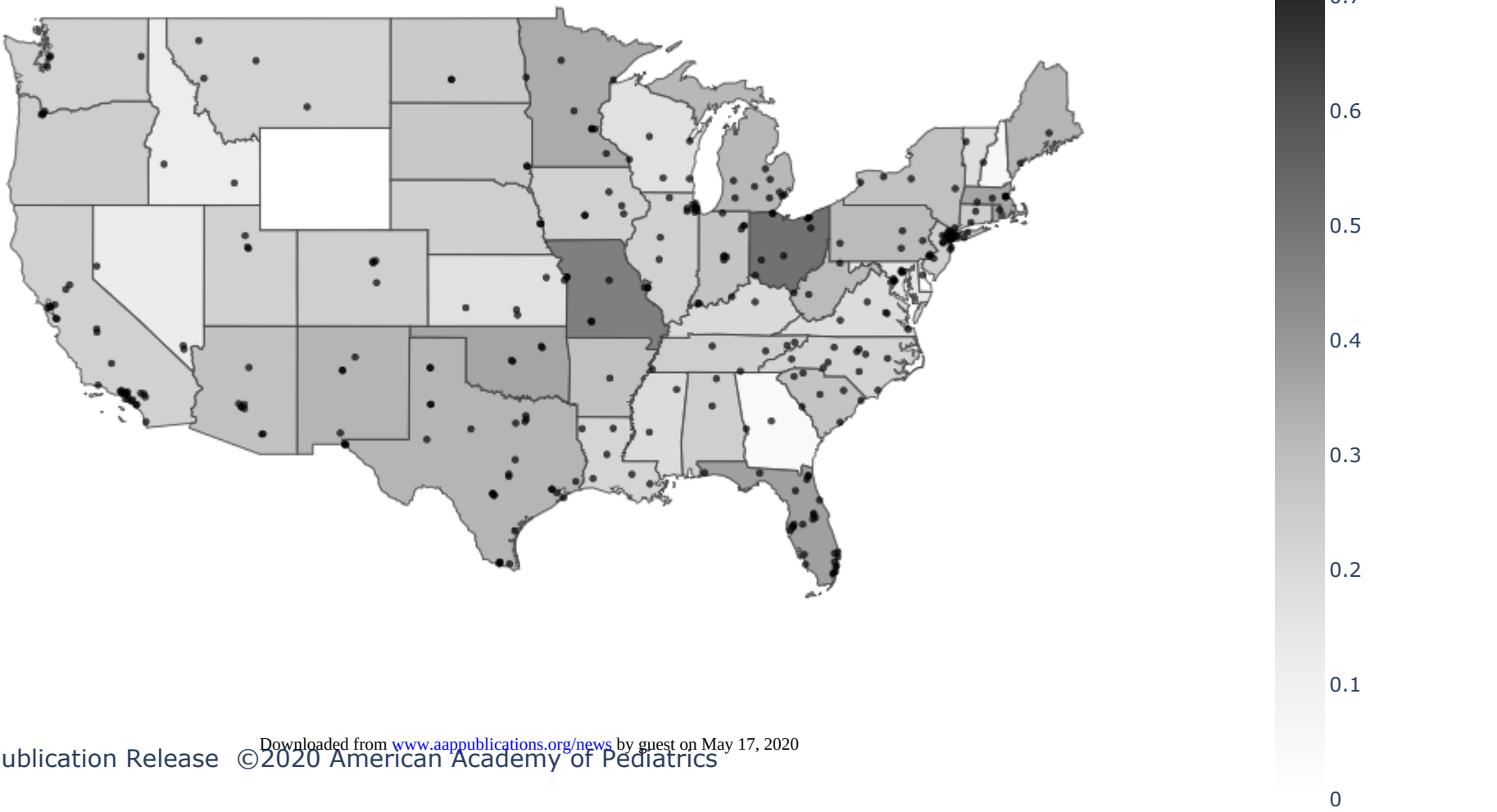
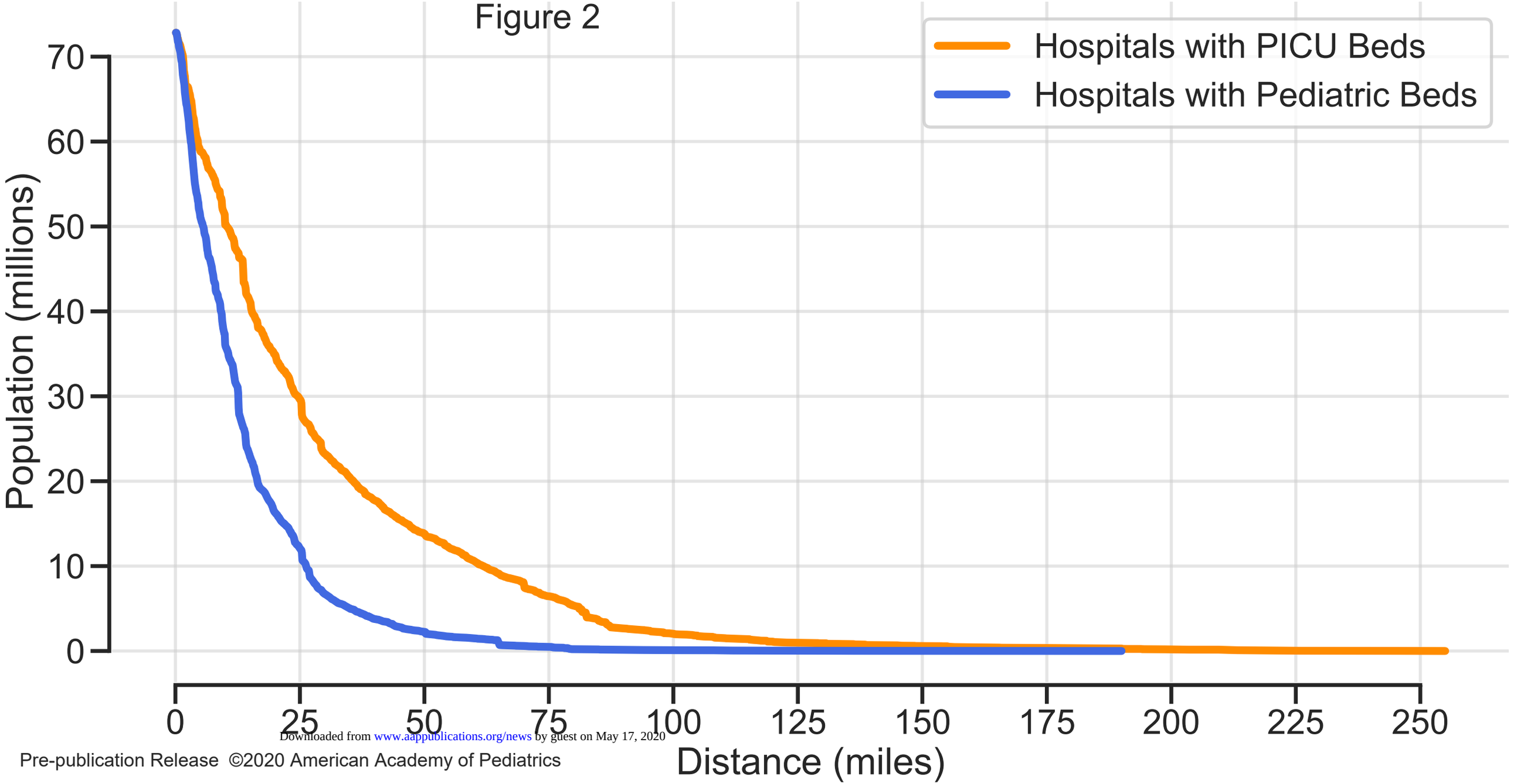


Figure 2



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