Geographic Information System Analysis of Demographics and Caries Burden

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BACKGROUND

- Early childhood caries (ECC) is the most common chronic disease of childhood, disproportionately affecting low-income and minority children
- Medicaid-insured children have lower use of prevention/early intervention dental services and greater reliance on walk-in emergency care as compared to privately insured peers
- Structural barriers—provider maldistribution, transportation challenges, and limited health literacy—contribute to persistent disparities
- Geographic Information Systems (GIS) can assess spatial access to dental care and identify community-level determinants of oral health outcomes
- Mapping the demographic and geographic distribution of our patient population may reveal utilization patterns and guide targeted, equity-focused interventions

OBJECTIVES

- Utilize GIS to analyze the spatial distribution and demographic characteristics of Medicaid-insured patients receiving care at an outpatient pediatric dentistry residency clinic in northern Manhattan
- Identify links between caries burden and sociodemographic patterns to inform patient-centered and community-responsive dental care delivery

MATERIALS & METHODS

Retrospective chart review of active dental patients treated at the NewYork-Presbyterian Children's residency clinic from 10/1/2022 – 10/1/2024

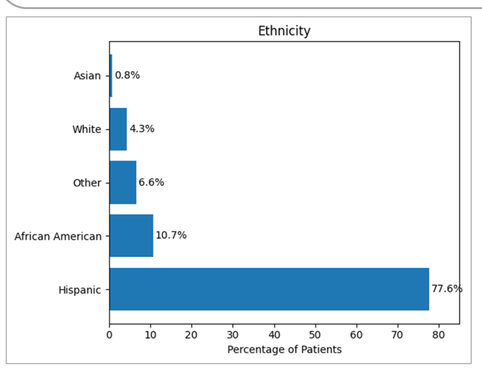
Extraction of demographic variables, clinical indicators, and healthcare utilization from EPIC EHR
- Age, sex, race, ethnicity, zip code, preferred language, SHCN status
- DMF/dmf/DMFS/dmfs indices, CAMBRA
- Number of emergency visits, total number and type of visits

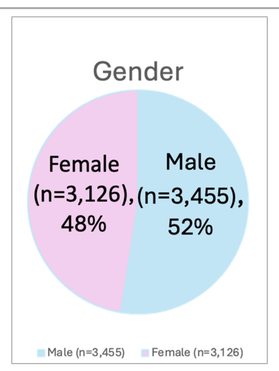
Assessments of clinic demographics & GIS
- Population diversity
- Walk-in emergency utilization
- Spatial distribution of routine versus emergency-only patients

Descriptive statistics and multilevel models were used to assess caries burden by age
- Primary dentition (ages 1–5)
- Mixed dentition (ages 6–13)
- Permanent dentition (ages 14–19)

RESULTS

- Population: 6,581 patients identified within the two-year period
- Among patients with emergency walk-ins: mean number of visits = 2.81 (SD = 2.08)
- Emergency-only walk-ins: 9.76% of patients (n = 642) utilized the clinic exclusively for walk-in emergencies, without establishing a dental home
- Age: Median age at last visit was 7 years (IQR: 5–9)





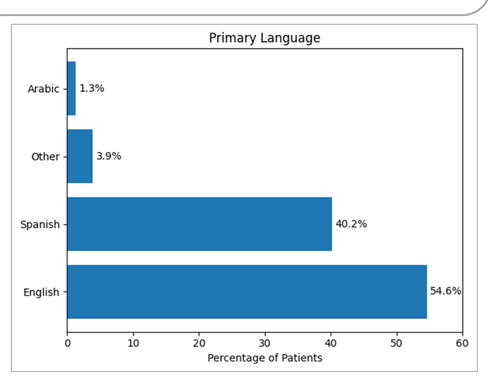


Table 1: Dental Caries Burden

Mean (SD) and % with ≥1 by age group

AGE GROUP	N	MEAN (SD)	% WITH ≥1
Ages 1–5			
DMF	2,178	0.01 (0.13)	0.6%
DMFS	2,178	0.01 (0.23)	
dmf	2,178	4.14 (5.25)	58.9%
dmfs	2,178	8.36 (13.28)	
Ages 6–13			
DMF	4,302	1.38 (2.46)	42.1%
DMFS	4,302	2.17 (4.39)	
dmf	4,302	5.22 (4.67)	75.9%
dmfs	4,302	12.32 (13.48)	
Ages 14–19			
DMF	92	6.23 (6.21)	79.3%
DMFS	92	10.25 (11.16)	
dmf	92	0.46 (1.14)	18.5%
dmfs	92	1.35 (3.57)	

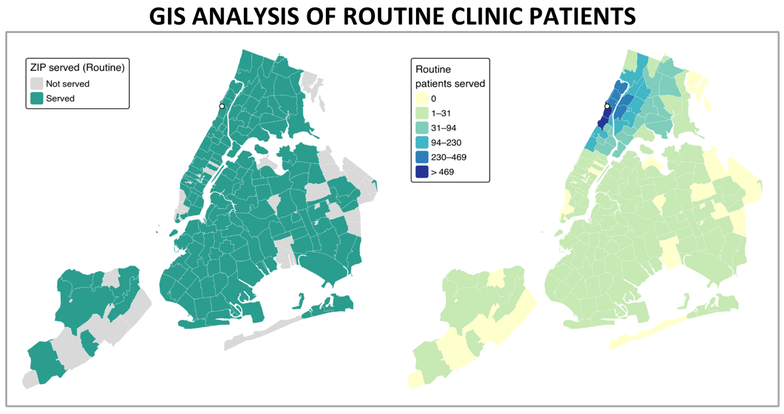
- Ages 1–5 years: Mean dmf = 4.14 (SD 5.25) and dmfs = 8.36 (SD 13.28), indicating a **substantial** burden of caries in the primary dentition
- Caries prevalence: 58.9% of children had dmf ≥1, meaning more than half experienced caries in at least one primary tooth

- Ages 6–13 years (primary dentition): Mean dmf = 5.22 (SD 4.67) and dmfs = 12.32 (SD 13.48), indicating high caries experience in retained primary teeth
- Caries prevalence (primary teeth): 75.9% of children had dmf ≥1, showing that the majority experienced caries in their primary dentition
- Permanent dentition: Mean DMF = 1.38 (SD 2.46) and DMFS = 2.17 (SD 4.39)
- Caries prevalence (permanent teeth): 42.1% of children had DMF ≥1, indicating nearly half had developed caries in permanent teeth

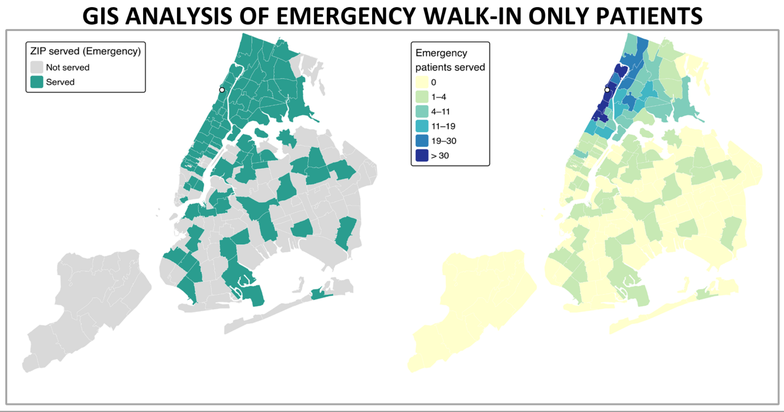
- Ages 14–19 years (permanent dentition): Mean DMF = 6.23 (SD 6.21) and DMFS = 10.25 (SD 11.16), indicating a considerable caries burden
- Caries prevalence: 79.3% of adolescents had DMF ≥1, showing that the majority experienced caries in at least one permanent tooth

GIS ANALYSIS

GIS ANALYSIS OF ROUTINE CLINIC PATIENTS



GIS ANALYSIS OF EMERGENCY WALK-IN ONLY PATIENTS



- **GIS analysis demonstrated spatial clustering of emergency-only visits**, with 80% of the patients originating from neighborhoods closest to the clinic in **Upper Manhattan and the Bronx**, suggesting that the clinic is in a **high-need area** where patient demand may exceed available capacity

DISCUSSION

- Emergency-only dental utilization was relatively high (9.7%, n = 642) and may reflect barriers to establishing a dental home, highlighting potential gaps in access to preventive dental care

Ages 1–5
- **Age was a strong predictor of primary dentition caries.**
- Among children aged 1–5, each additional year of age was associated with a **77% increase in the odds of having any primary caries (OR = 1.77, p < .001)**.

Ages 6–13
- **Age was a strong predictor of permanent dentition caries.**
- Among children aged **6–13**, each additional year of age was associated with a **91% increase in the odds of having any permanent caries (OR = 1.91, p < .001).**

Predictive Caries Burden
- **Primary dentition caries was strongly associated with permanent dentition caries.**
- Children with any primary caries had **79% higher odds of having caries in the permanent dentition (OR = 1.79, p < .001).**

CONCLUSIONS

- Pediatric patients in this clinic population experience a **substantial burden of dental caries beginning early in life**
- **ECC may contribute to continued disease progression into permanent dentition**, emphasizing the importance of **prevention education/anticipatory guidance and early intervention**
- **Spatial clustering of emergency-only walk-ins** suggests opportunities for **targeted referrals, directed community outreach and prevention education programs** in high-utilization neighborhoods
- Expanding **access and establishing dental homes** may help reduce emergency-driven utilization and long-term caries burden

LIMITATIONS

- **Incomplete Cambra documentation**: 21.8% of patients lacked a recorded Cambra assessment, limiting evaluation of the association between caries burden and risk status. Among patients with documented Cambra (excluding emergency-only visits), **51% were high risk (n = 2,591), 36% moderate (n = 1,839), and 13% low (n = 653)**. Missing assessments may underestimate the true prevalence of caries risk.
- **Underrepresentation of SHCN**: Only 12.8% of patients (n = 841) were identified as having special health care needs (SHCN). Because SHCN designation relied solely on scheduling labels, the true prevalence is likely underestimated; clinic estimates suggest the SHCN population may be closer to ~60%, which would require a full retrospective chart review to confirm.
- Further research should also assess the geographic distribution of caries burden using GIS-based analyses to identify spatial patterns and communities with the greatest unmet preventive dental care needs.

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