

Supplemental Information

SUPPLEMENTAL TABLE 3 Codes Used to Identify the Cohort of CMC

Codes Used for Inclusion ^a		
Major Categories	Subcategories	ICD-9 Diagnosis Codes
Neuromuscular	Brain and spinal cord malformations	740.0–742.9
	Mental retardation	318.0–318.2
	Central nervous system degeneration and disease	330.0–330.9, 334.0–334.2, 335.0–335.9
	Infantile cerebral palsy	343.0–343.9
	Muscular dystrophies and myopathies	359.0–359.3
Cardiovascular	Heart and great vessel malformations ^b	745.0–747.4
	Cardiomyopathies	425.0–425.4, 429.1
	Conduction disorders and dysrhythmias	426.0–427.4, 427.6–427.9
Respiratory	Respiratory malformations	748.0–748.9
	Chronic respiratory disease	770.7
	Cystic fibrosis	277.0
Other	Congenital anomalies	753.0–753.9
	Chronic renal failure	585
	Congenital anomalies	750.3, 751.1–751.3, 751.6–751.9
	Chronic liver disease and cirrhosis	571.4–571.9
	Inflammatory bowel disease	555.0–556.9
	Sickle cell disease	282.5–282.6
	Hereditary anemias	282.0–282.4
	Hereditary immunodeficiency	279.0–279.9, 288.1–288.2, 446.1
	HIV disease	0420–0421
	Amino acid metabolism	270.0–270.9
	Carbohydrate metabolism	271.0–271.9
	Lipid metabolism ^c	272.5–272.9
	Storage disorders	277.3, 277.5
	Other metabolic disorders	275.0–275.3, 277.2, 277.4, 277.6, 277.8–277.9
	Chromosomal anomalies	758.0–758.9
	Bone and joint anomalies ^d	259.4, 737.3, 756.0–756.5
Diaphragm and abdominal wall	553.3, 756.6–756.7	
Other congenital anomalies	759.7–759.9	
Malignancy	Malignant neoplasms	140.0–208.9, 235.0–239.9
Technology dependence	Tracheostomy, gastrostomy, and extracranial ventricular shunt ^d	43.1, 31.2, 02.3, V44.1, V44.0
Codes Used for Exclusion ^e		
Major Categories	Subcategories	ICD-9 Procedure Codes
Transplant	Liver transplant	50.5, 50.51, 50.59
	Kidney transplant	55.6, 55.61, 55.69
	Bone marrow transplant	41.0–41.9
Cardiac surgery	Cardiac surgery ^f	35.0–37.99

Adapted from definitions of pediatric complex chronic conditions by Feudtner and Simon.

^a To meet the definition for inclusion in our cohort of CMC, patients had to have at least 1 hospitalization or at least 2 separate outpatient visits containing the listed codes.

^b The codes for atrial septal defect (ASD) (745.5) and ventricular septal defect (VSD) (745.4) were not used for this study.

^c Although used in earlier definitions, the codes 272.0–272.4 were excluded in this study to only lipid disorders related to inborn errors of metabolism.

^d Children for whom the only qualifying diagnosis was a bone or joint anomaly or technology dependence were not included in the study cohort. For children with a different qualifying diagnosis, these codes were considered as comorbid conditions.

^e Patients undergoing a procedure identified by the following CPT codes were excluded from the cohort, as these services were available at a single hospital under study.

^f Patients were not excluded based on receiving percutaneous valvuloplasty (35.96) or cardiac catheterization (35.21–35.23), as these services were available at the other children's hospitals in the region.

SUPPLEMENTAL TABLE 4 Specialty Services Available by Hospitals Analyzed

Service	Children's Hospitals				Regional Hospitals	
	Freestanding	Within a Hospital			Hospital E	Hospital F
	Hospital A	Hospital B	Hospital C	Hospital D		
PICU	√	√	√	√	√	√
NICU (AAP level)	√ (IV)	√ (III)	√ (III)	√ (III)	√ (III)	√ (III)
CF care center	√	√	√	√		√
Medical						
Hematology/Oncology	√	√	√	√		√
Neurology	√	√	√	√	√	
Cardiology	√	√	√	√		√
Nephrology	√	√	√	√	√	
Gastroenterology	√	√	√	√	√	
Rheumatology	√	√	√	√		
Developmental	√	√	√	√	√	√
Genetics	√	√	√	√		√
Endocrine	√	√	√	√		√
Ophthalmology	√	√	√			
Surgical						
Orthopedics	√	√	√	√	√	√
Urology	√	√	√	√		√
Otolaryngology	√	√	√	√		
Cardiac ^a	√					
Transplant ^a	√					
Pediatric GME program	√	√	√	√		

√, services were available during the study period.

AAP, American Academy of Pediatrics; CF, cystic fibrosis; GME, graduate medical education.

^a Children receiving solid organ or bone marrow transplantation and those undergoing complex congenital heart repair were excluded from the cohort due to the availability of these services only at hospital A. The codes used to identify these procedures are shown in Supplemental Table 1.

SUPPLEMENTAL TABLE 5 Sensitivity Analysis Comparing Variation in Patient Encounters Among Study Hospital Cohorts After Including Entire Northern New England CMC Population

Utilization Measure	Hospital ^a	Adjusted Relative Rates ^b (95% Confidence Interval)		
		Main Model ^c	Sensitivity Analysis ^d	Difference
Inpatient days	A	2.26 (2.20–2.33)	2.29 (2.22–2.35)	0.03
	B	0.84 (0.82–0.86)	0.84 (0.82–0.87)	0
	C	0.94 (0.91–0.97)	0.94 (0.92–0.97)	0
	D	Referent	Referent	0
	E	0.55 (0.52–0.57)	0.55 (0.53–0.58)	0
	F	1.34 (1.29–1.38)	1.38 (1.33–1.43)	0.04
ICU days	A	2.18 (2.02–2.36)	2.24 (2.07–2.43)	0.06
	B	0.78 (0.72–0.85)	0.77 (0.71–0.84)	–0.01
	C	1.75 (1.63–1.88)	1.75 (1.63–1.89)	0
	D	Referent	Referent	0
	E	0.48 (0.41–0.55)	0.48 (0.41–0.55)	0
	F	0.10 (0.07–0.13)	0.10 (0.07–0.13)	0
Office visits	A	1.16 (1.13–1.18)	1.16 (1.13–1.19)	0
	B	0.80 (0.79–0.82)	0.79 (0.78–0.81)	–0.01
	C	1.06 (1.04–1.08)	1.05 (1.03–1.08)	–0.01
	D	1.18 (1.15–1.21)	1.18 (1.15–1.20)	0
	E	Referent	Referent	0
	F	0.54 (0.53–0.56)	0.53 (0.51–0.55)	–0.01
ED visits	A	1.38 (1.29–1.49)	1.38 (1.29–1.49)	0
	B	0.72 (0.67–0.77)	0.70 (0.66–0.75)	–0.02
	C	1.01 (0.95–1.08)	1.01 (0.94–1.07)	0
	D	0.90 (0.84–0.97)	0.89 (0.83–0.96)	–0.01
	E	Referent	Referent	0
	F	0.74 (0.68–0.81)	0.72 (0.66–0.78)	–0.02

^a Hospital A is a freestanding children's hospital. Hospitals B, C, and D are children's hospitals within academic medical centers. Hospitals E and F are regional hospitals.

^b Adjusted for age, gender, payer, median household income, primary diagnosis, presence of a comorbid condition, and technology dependence. The reference group for each event is the study hospital whose adjusted rate most closely matched that of the overall northern New England cohort.

^c Main model is the primary analysis as presented in Figure 1. Included are only CMC residing in Maine, New Hampshire, and Vermont attributed to 1 of the 6 study hospitals.

^d Sensitivity analysis includes all CMC residing in Maine, New Hampshire, and Vermont regardless of hospital of attribution. Hospitals with 50–199 attributed patients entered the model as individual cohorts, whereas hospitals with <50 attributed CMC were combined into a single group. Only results for the 6 hospital cohorts comprising the study population are shown here.

SUPPLEMENTAL TABLE 6 Sensitivity Analysis Comparing Variation in Imaging Utilization Among Study Hospital Cohorts After Including Entire Northern New England CMC Population

Utilization Measure	Hospital ^a	Adjusted Relative Rates ^b (95% Confidence Interval)		
		Main Model ^c	Sensitivity Analysis ^d	Difference
Chest radiographs	A	1.26 (1.20–1.33)	1.28 (1.22–1.35)	0.02
	B	0.79 (0.75–0.83)	0.78 (0.74–0.81)	–0.01
	C	Referent	Referent	0
	D	0.86 (0.82–0.91)	0.86 (0.82–0.91)	0
	E	0.75 (0.70–0.81)	0.75 (0.70–0.81)	0
	F	0.98 (0.92–1.05)	0.96 (0.89–1.02)	–0.02
Abdominal radiographs	A	1.16 (0.98–1.36)	1.20 (1.03–1.41)	0.04
	B	0.87 (0.76–1.00)	0.88 (0.76–1.01)	0.01
	C	1.44 (1.25–1.65)	1.47 (1.28–1.69)	0.03
	D	1.33 (1.15–1.54)	1.36 (1.17–1.57)	0.03
	E	0.73 (0.60–0.88)	0.75 (0.62–0.90)	0.02
	F	Referent	Referent	0
Chest/abdominal CT	A	1.30 (1.02–1.64)	1.33 (1.05–1.68)	0.03
	B	Referent	Referent	0
	C	1.05 (0.88–1.27)	1.07 (0.89–1.28)	0.02
	D	1.55 (1.29–1.86)	1.56 (1.30–1.88)	0.01
	E	0.34 (0.22–0.53)	0.35 (0.22–0.55)	0.01
	F	1.63 (1.29–2.06)	1.61 (1.27–2.03)	–0.02
Head CT	A	0.93 (0.70–1.24)	0.96 (0.72–1.28)	0.03
	B	1.34 (1.06–1.70)	1.35 (1.07–1.70)	0.01
	C	0.73 (0.56–0.93)	0.73 (0.57–0.94)	0
	D	0.98 (0.75–1.27)	0.99 (0.76–1.29)	0.01
	E	0.64 (0.45–0.91)	0.65 (0.45–0.93)	0.01
	F	Referent	Referent	0
Head MRI	A	0.85 (0.65–1.11)	0.86 (0.66–1.12)	0.01
	B	0.68 (0.54–0.85)	0.68 (0.54–0.85)	0
	C	1.81 (1.47–2.23)	1.83 (1.49–2.25)	0.02
	D	0.61 (0.47–0.79)	0.62 (0.48–0.80)	0.01
	E	0.60 (0.43–0.83)	0.61 (0.44–0.84)	0.01
	F	Referent	Referent	0

^a Hospital A is a freestanding children's hospital. Hospitals B, C, and D are children's hospitals within academic medical centers. Hospitals E and F are regional hospitals.

^b Adjusted for age, gender, payer, median household income, primary diagnosis, presence of a comorbid condition, and technology dependence. The reference group for each event is the study hospital whose adjusted rate most closely matched that of the overall northern New England cohort.

^c Main model is the primary analysis as presented in Figure 2. Included are only CMC residing in Maine, New Hampshire, and Vermont attributed to 1 of the 6 study hospitals.

^d Sensitivity analysis includes all CMC residing in Maine, New Hampshire, and Vermont regardless of hospital of attribution. Hospitals with 50–199 attributed patients entered the model as individual cohorts, whereas hospitals with <50 attributed CMC were combined into a single group. Only results for the 6 hospital cohorts comprising the study population are shown here.

SUPPLEMENTAL TABLE 7 Sensitivity Analysis Comparing Variation in Diagnostic Testing Among Study Hospital Cohorts After Including Entire Northern New England CMC Population

Utilization Measure	Hospital ^a	Adjusted Relative Rates ^b (95% Confidence Interval)		
		Main Model ^c	Sensitivity Analysis ^d	Difference
Electrocardiograms	A	2.88 (2.61–3.17)	2.89 (2.62–3.18)	0.01
	B	0.48 (0.43–0.54)	0.48 (0.42–0.54)	0
	C	1.11 (1.00–1.22)	1.10 (1.00–1.22)	–0.01
	D	Referent	Referent	0
	E	0.65 (0.56–0.76)	0.65 (0.56–0.76)	0
	F	0.35 (0.28–0.44)	0.34 (0.27–0.43)	–0.01
Echocardiograms	A	1.96 (1.77–2.17)	1.97 (1.78–2.18)	0.01
	B	0.84 (0.76–0.93)	0.83 (0.75–0.92)	–0.01
	C	Referent	Referent	0
	D	0.78 (0.69–0.88)	0.78 (0.69–0.88)	0
	E	0.67 (0.57–0.79)	0.68 (0.57–0.79)	0.01
	F	0.22 (0.16–0.29)	0.22 (0.16–0.29)	0
Renal ultrasounds	A	0.63 (0.50–0.78)	0.63 (0.50–0.78)	0
	B	0.63 (0.53–0.74)	0.62 (0.53–0.73)	–0.01
	C	1.41 (1.23–1.61)	1.41 (1.23–1.61)	0
	D	Referent	Referent	0
	E	0.50 (0.39–0.62)	0.50 (0.40–0.63)	0
	F	0.45 (0.33–0.59)	0.44 (0.33–0.59)	–0.01
EEG	A	1.50 (1.21–1.86)	1.51 (1.22–1.88)	0.01
	B	0.78 (0.63–0.96)	0.77 (0.62–0.95)	0.01
	C	1.73 (1.44–2.07)	1.72 (1.44–2.06)	–0.01
	D	Referent	Referent	0
	E	0.77 (0.57–1.05)	0.78 (0.57–1.05)	0.01
	F	0.41 (0.28–0.61)	0.40 (0.27–0.60)	–0.01

^a Hospital A is a freestanding children's hospital. Hospitals B, C, and D are children's hospitals within academic medical centers. Hospitals E and F are regional hospitals.

^b Adjusted for age, gender, payer, median household income, primary diagnosis, presence of a comorbid condition, and technology dependence. The reference group for each event is the study hospital whose adjusted rate most closely matched that of the overall northern New England cohort.

^c Main model is the primary analysis as presented in Figure 3. Included are only CMC residing in Maine, New Hampshire, and Vermont attributed to 1 of the 6 study hospitals.

^d Sensitivity analysis includes all CMC residing in Maine, New Hampshire, and Vermont regardless of hospital of attribution. Hospitals with 50–199 attributed patients entered the model as individual cohorts, whereas hospitals with <50 attributed CMC were combined into a single group. Only results for the 6 hospital cohorts comprising the study population are shown here.