The Healthcare Cost of Symptomatic Congenital CMV Disease in Privately Insured US Children: Estimates from Administrative Claims Data

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Symptomatic Congenital CMV Disease

- Congenital CMV infection (cCMV) occurs in 0.4-0.5% of US infants
  - Leading viral cause of birth defects and hearing loss in US children
  - ≈10-15% symptomatic at birth (Dreher et al. 2014)
  - Symptoms include
    - Jaundice, petechiae, purpura, hepatosplenomegaly, seizures, chorioretinitis, and microcephaly
    - Abnormal laboratory and brain imaging findings
    - Preterm birth and intrauterine growth restriction
  - Complications include
    - Sensorineural hearing loss (SNHL), cerebral palsy, intellectual disability, vision impairment

Previous Cost Estimates – CROCUS Study

- CROCUS retrospective cohort study from the Netherlands (Korndewal et al. 2018)
  - 31,484 stored blood spots for 5-year-old children were tested for CMV DNA with parental consent
    - 156 (0.5%) positive for cCMV, 4 with previous diagnoses of cCMV
    - Medical records retrieved for 133 children with cCMV and 274 matched CMV-negative children
  - 26/133 (20%) symptomatic based on presence of
    - preterm birth, small for gestational age, microcephaly, hepatomegaly or splenomegaly, generalized petechiae or purpura, seizures or hypotonia, thrombocytopaenia, neutropaenia, elevated alanine transaminase, conjugated hyperbilirubinaemia, neonatal sensorineural hearing loss, cranial ultrasound abnormalities or ophthalmological abnormalities

Cost Estimates from the Netherlands

- Mean cost during first 6 years of life in US dollars

	Number	Mean cost in US dollars
Children without cCMV	274	$4,362
Children with cCMV	133	$7,519
Asymptomatic at birth	107	$4,588
Symptomatic at birth	26	$19,584

- Strengths of CROCUS study
  – Nationally representative cohort
  – Review of medical charts with clinical diagnoses and lab tests
- Limitation: Retrospective symptomatic classification

New Analysis of US Health Insurance Claims Data

Analysis of Private Health Insurance Claims Data

- No US cost estimates for cCMV
- New, unpublished secondary analysis of US administrative healthcare data on payments to healthcare providers
  - Payments used as proxy for resource cost of providing care
  - Payments and costs are typically much lower than charges (list prices)
    - Example: Mean cost vs. charge of hospital admissions with principal diagnosis of cCMV during 2014 (www.HCUPnet.gov)
      - Mean cost $36,139
      - Mean charge $122,273 (3.4 times estimated cost)
- Purpose of new study: Estimate per-child expenditures for privately insured US children with cCMV diagnosis codes

Data Source

- IBM MarketScan® research databases licensed by CDC
  - Commercial Claims and Encounters data supplied by large employers and health plans contracting with employers
  - More than 100 million unique enrollees, both employees and dependents, including children up to 26 years of age
    - Enrollee ID allows longitudinal analysis of healthcare use and expenditures subject to attrition of plans and individual enrollees
  - Includes inpatient, outpatient and pharmacy Diagnosis codes, procedure codes, and drug codes
    - Plan expenditures (reimbursements to providers)
    - Expected out-of-pocket payments (remaining allowable charge)

Description of Study Cohort

- Records for 100,566,107 insured persons enrolled at some point during 1/1/2010 – 7/31/2017
- Records for 1,129,498 newborns with a V30-39 live birth code during 1/1/10 – 12/31/2012
- Restricted to 709,745 children with an inpatient admission with a live birth code during the first 7 days in the database (presumed birth hospitalization)
  - 435,622 children enrolled at least 11 months in first year
  - 274,817 children enrolled at least 11 months in fourth year

Children with a cCMV Diagnosis Code

- Searched for infants who had ICD-9-CM codes of 771.1 (congenital CMV infection) or 078.5 (cytomegaloviral disease) in the first 28 days
  - Previous analyses used broader time window of 45 days (Leung et al. 2013; 2018)
  - Laboratory testing for cCMV should be done in first 4 weeks of life
- 50 of 274,817 children, or 1.8 per 10,000 children
  - Tip of the iceberg in terms of cCMV cases
    - Few infants identified with cCMV in absence of newborn screening
  - Most were likely referred for CMV testing based on symptoms
  - Some may be false-positive or rule-out diagnoses

Classification of Symptomatic cCMV Cases

- Searched for diagnoses codes indicative of clinically significant symptoms prior to and within 28 days of cCMV diagnosis
  - Health problems associated with preterm birth or low birth weight
  - Microcephaly, brain anomalies, cerebral palsy, seizures
  - Enlarged spleen or liver, retinitis or chorioretinitis
  - Jaundice, skin rashes
- 35 (70%) classified as symptomatic
- Other 15 cases may have had milder neonatal symptoms
  - 2 had diagnosis of hearing loss prior to CMV diagnosis

Cumulative Total Expenditures in First 4 Years of Life

- 274,767 children without cCMV
  - Mean $24,559
  - Median $9,620
- 50 children with a cCMV code in first 28 days
  - Mean $415,843
  - Median $79,156
- 7 children with first CMV code at days 29-45
  - Mean $50,581
  - Median $7,275

4-year Expenditures by cCMV Case Type

- Clinically symptomatic cases (n=35)
  - Mean $557,920 22.7 times as high as non-cCMV cohort
  - Median $242,336 25.2 times as high as non-cCMV cohort
- Other cases (n=15)
  - Mean $37,655 1.5 times as high as non-cCMV cohort
  - Median $13,494 1.4 times as high as non-cCMV cohort

Out-of-Pocket Medical Expenditures for Families

- In the general pediatric population the median child had out-of-pocket expenditures during 4 years of $1,508
- Among 35 children with clinically symptomatic cCMV, median out-of-pocket expenditures were almost 4 times as high, $6,766 per child
  - Added cost to family of more than $1,300 per year
  - Children with neurological complications had median out-of-pocket expenditures of $8,511

Hearing Loss in cCMV Cohort

- SNHL: ≥2 ICD-9/10 codes for SNHL in first 4 years and ≥7 days apart
- SNHL clinically diagnosed in 26% of children
  - 10 (29%) of 35 children with clinically symptomatic cCMV (next slide)
  - 3 (20%) of 15 other children with cCMV (subsequent slide)
- Amplification (hearing aids and/or cochlear implants)
  - Of 13 children with SNHL, 5 had hearing aids fit and 3 subsequently received cochlear implants
  - Cumulative per-child spending in first 4 years associated with hearing amplification/implant procedure codes
    - 3 children with cochlear implants $97,956
    - 2 children with hearing aids only $2,799

Stratified Cost Estimates in Symptomatic cCMV Cohort

- Neurological complications
  - 15 of 50 (30%) had neurological complications (e.g. microcephaly)
  - 14 of 35 (40%) in clinically symptomatic group (as newborns)
    - Mean expenditure $948,393
- Prematurity
  - 25 of 50 (50%) coded as having problems due to preterm birth or low birth weight (all included in clinically symptomatic group)
  - 11 of 14 (79%) of those with neurological & symptomatic group
  - 14 of 21 (67%) of other symptomatic children
    - Mean expenditure $446,334
    - 7 children not preterm or LBW had $100,085 mean expenditures

Expenditures for 35 Children with Symptomatic cCMV without and with Hearing Loss during First 4 Years

		Number of children	Mean expenditure	Median expenditure
Neurological conditions	Without SNHL	7	$1,060,050	$516,294
	With SNHL	7	$836,736	$334,860
Prematurity without neurological conditions	Without SNHL	11	$508,512	$483,591
	With SNHL	3	$218,488	$187,498
No prematurity or neurological conditions	Without SNHL	7	$100,085	$24,510
	With SNHL	0	---	---

Costs for Children with Mildly Symptomatic or Asymptomatic cCMV

- Of 15 children not classified as symptomatic
  - 3 children had SNHL, including 2 with SNHL prior to cCMV diagnosis
    - Mean expenditure $59,556
    - Median expenditure $51,760
  - 1 child had microcephaly $236,508 expenditure
    - Diagnosed at 119 days – should child be included in clinically symptomatic cohort?
  - The other 11 children (no SNHL, not microcephalic) had considerably lower expenditures
    - Mean expenditure $13,617
    - Median expenditure $8,171

Study Limitations

- Accuracy of estimates affected by false-positive and false-negative diagnostic and procedural codes
- Study findings cannot be generalized to national-level economic burden of cCMV because:
  - Study did not include children covered by public payers or by non-employer-sponsored health plans
  - Only a minority of infants with clinically symptomatic cCMV are currently tested for and diagnosed with cCMV

Conclusions - 1

- Privately insured children with recognized symptomatic cCMV had 4-year expenditures >20 times as great as other privately insured US children
  - Ratio 5 times that reported in Dutch CROCUS study
  - Differences in study designs, case definitions, and healthcare systems presumably account for differences in findings
- Most excess medical costs for children with symptomatic cCMV appear are among those who had neurological complications and/or prematurity

Conclusions - 2

- Hearing loss is the most common complication of cCMV
  - Hearing loss adds little to medical costs for children with moderately to severely symptomatic cCMV
  - Among children with asymptomatic or unrecognized symptomatic cCMV who were diagnosed with cCMV as neonates, children with hearing loss had higher medical expenditures
- Congenital CMV poses substantial costs to the US healthcare sector, health plans, and families
  - In addition to out-of-pocket medical costs, families often incur costs associated with caring for children with disabilities
    - Includes lost income because of caregiving responsibilities

Cited References

- Dreher AM, Arora N, Fowler KB, et al. Spectrum of disease and outcome in children with symptomatic congenital cytomegalovirus infection. *Journal of Pediatrics*. 2014;164:855-9
- Korndewal MJ, Weltevrede M, van den Akker-van Marle ME, et al. Healthcare costs attributable to congenital cytomegalovirus infection. *Archives of Disease in Childhood*. 2018;103:452-7.
- Leung J, Cannon MJ, Grosse SD, Bialek SR. Laboratory testing and diagnostic coding for cytomegalovirus among privately insured infants in the United States: a retrospective study using administrative claims data. *BMC Pediatrics*. 2013;13:90.
- Leung J, Dollard S, Grosse SD, et al. Valganciclovir use among infants with congenital CMV infection in the United States, 2009-2015. *Clinical Therapeutics*. 2018;40:430–9.

For more information, contact CDC
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