

# Healthcare Resource Utilization and Costs of Myotubular Myopathy in England

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## Background

- X-linked myotubular myopathy (XLMTM) is a rare, life-threatening congenital myopathy characterized by profound muscle weakness leading to impairment of respiratory and neuromuscular function<sup>1,2</sup>
- XLMTM is associated with high rates of healthcare utilization, hospitalization, and surgical intervention<sup>3-5</sup>
- Most children with XLMTM have significant dependence on invasive mechanical ventilation (>16 hours/day)<sup>4</sup>, feeding tubes, wheelchairs, and home health services<sup>6</sup>
- Estimated mean annual healthcare costs of XLMTM in the US are highest in the first year of life (\$897,978) and decrease to \$113,285 by the fourth, totalling nearly \$1.5 million for individuals who survive their first four years of life<sup>6</sup>
- Healthcare resource use utilization associated with XLMTM in England is largely unknown
- This study provides estimates on healthcare resource utilization (HCRU) and associated costs of care for patients with myotubular myopathies (MTM); including but not limited to XLMTM in England

- The study was a retrospective review of medical records of MTM cases identified from males in the general population of England

Table 1. Summary of study characteristics

Parameter	Study features
Design	Retrospective
Participants	Review of data from 16.9 million males (all ages) from the general population of England
Data	De-identified linked electronic medical records (EMR) from <b>primary care</b> (CPRD: Gold, Aurum) and <b>secondary care</b> (HES: outpatient, admitted patient care, A&E)
Study period	01Jan2000 to 31Dec2019 (20 years)
Entry into study	Latest date of: current registration date <sup>a</sup> , the GP practice up-to-standard date <sup>b</sup> , age 0 years, or the study period start date
Follow-up	Until death, study period end or last data collection date

<sup>a</sup>Current registration date is the date when a patient enters the database, i.e. when they register with a GP practice that participates in the CPRD. <sup>b</sup>The up-to-standard date is the date from which CPRD considers the data from a practice to be of sufficient quality for research purposes.

## Objectives and Methods

- The data comprised de-identified primary care electronic medical records (EMR) from the Clinical Practice Research Datalink (CPRD) linked with secondary care EMR from Hospital Episode Statistics (HES) (Table 1)
- MTM cases were identified by using Readcodes in primary care and ICD codes in secondary care (Table 2). We used a **narrow definition** and a **broad definition** of myopathies. Patients were classified as a MTM case if they had any of these codes in their linked EMR
- Descriptive statistics of HCRU for the number GP visits, number of A&E visits, number of hospital outpatient visits, number of inpatient admissions, and total length of stay in hospital for the inpatient admissions are reported
- Costs were estimated using Healthcare Resource Groups obtained from the NHS Grouper Tool, and costs expressed as per patient per year (PPPY) in 2021 GBP
- The rate approach was used to calculate the means, in which all patients' costs were summed up and divided by the total duration of follow-up in patient years

Table 2. Narrow and broad definitions of MTM used in the study

Setting, Database and Code format	Code	Description	MTM definition	
			Narrow	Broad
<b>Primary care (Gold, Aurum): Readcode</b>	F39z.00	Myopathy or muscular dystrophy NOS		X
	Fyu8900	[X]Myopathy in other diseases classified elsewhere		X
	F390200	Centronuclear myopathy		X
	F390300	Myotubular myopathy	X	X
	F390500	Congenital myopathy		X
<b>Secondary care (HES): ICD-10</b>	F390z00	Congenital hereditary muscular dystrophy NOS		X
	G71	Primary disorders of muscles: Muscular dystrophy, congenital myopathies, others		X
	G71.0	Muscular dystrophy		X
	G71.2	Congenital myopathies	X	X
	G71.8	Other primary disorders of muscles		X
G71.9	Primary disorder of muscle, unspecified		X	

## Results

### MTM Narrow Definition

- MTM cases identified by narrow definition included those with Readcode F390300 or ICD-10 code G71.2
- Using the narrow definition, there were 377 cases, with median (IQR) age 14 years (4–29 years) and follow-up 4.1 years (1.7–8.9 years)
- The number of episodes and associated costs of healthcare resources used per patient per year (PPPY) during follow-up are shown in Table 3 (episodes), Figure 1 (mean costs) and Figure 2 (median costs)
- Some patients had exceptionally high HCRU within a short follow-up period, which inflated PPPY costs; hence, the 95th percentiles of costs PPPY were also included in the analysis (Figure 3)
- Median (IQR) **total costs** (defined as the sum of inpatient, outpatient, A&E visit, and GP visit costs) PPPY were £4,050 (£1,659–£16,219) and the 95th percentile was £67,882
- By age group, the largest costs were seen in 0- to 4-year-olds (Figures 1–3)

Table 3. HCRU and associated costs per patient per year (PPPY) for patients with MTM classified by the narrow definition (N=377)

Healthcare resource	Number of episodes PPPY		Cost PPPY (GBP)	
	Median	IQR	Median	IQR
GP visits	6.1	2.8–13.2	£239	£110 – £515
Outpatient visits	5.2	1.7–10.3	£621	£214 – £1,543
Inpatient admissions	0.9	0.2–3.0	£2,485	£732–£11,483
Length of stay	1.9 days	0.3–9.5		

### MTM Broad Definition

- Broad definition MTM cases included all codes listed in Table 2
- Using the broad definition, there were 4,140 cases, with median (IQR) age 40 years (18–61 years) and follow-up 3.9 years (1.4–8.5 years)
- The number of episodes and associated costs of healthcare resources used (PPPY) during follow-up are shown in Table 4 (episodes), Figure 4 (mean costs) and Figure 5 (median costs)
- Some patients had exceptionally high HCRU within a short follow-up period, which inflated PPPY costs; hence, the 95th percentiles of costs PPPY were also included in the analysis (Figure 6)
- Median (IQR) **total costs** (defined as the sum of inpatient, outpatient, A&E visit, and GP visit costs) PPPY were £2,678 (£868–£8,435) and the 95th percentile was £82,839

Table 4. HCRU and associated costs per patient per year (PPPY) for patients with MTM classified by the broad definition (N=4,140)

Healthcare resource	Number of episodes PPPY		Cost PPPY (GBP)	
	Median	IQR	Median	IQR
GP visits	6.7	2.9–13.1	£260	£113 – £511
Outpatient visits	2.9	0 – 6.7	£329	£13 – £970
Inpatient admissions	0.6	0 – 2.0	£1,440	£215 – £5,826
Length of stay	1.2 days	0 – 7.1		

MTM narrow definition, MEAN costs PPPY (N=377)

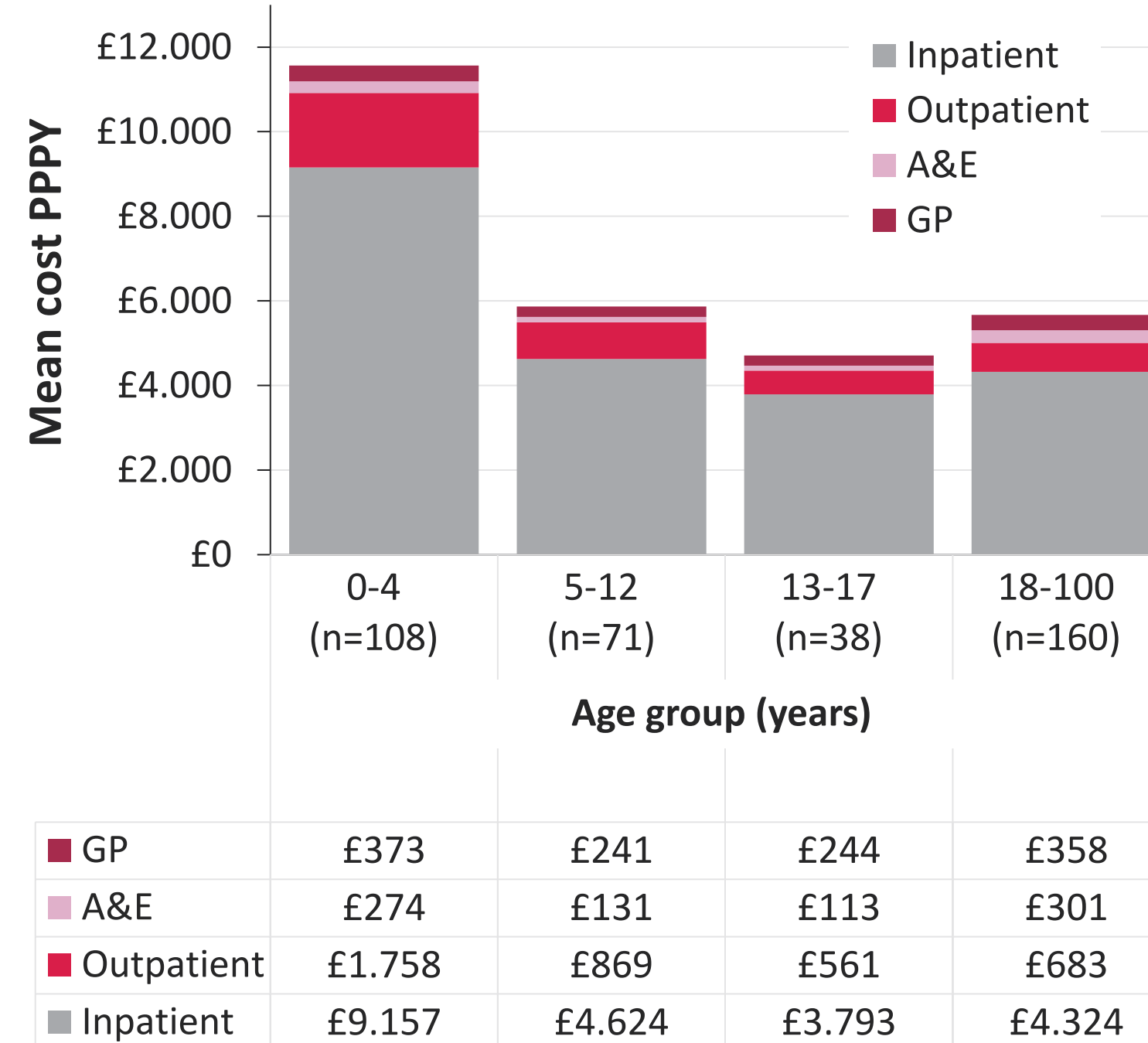


Figure 1. Mean cost PPPY by age group and service for patients with MTM classified by the narrow definition

MTM narrow definition, MEDIAN costs PPPY (N=377)

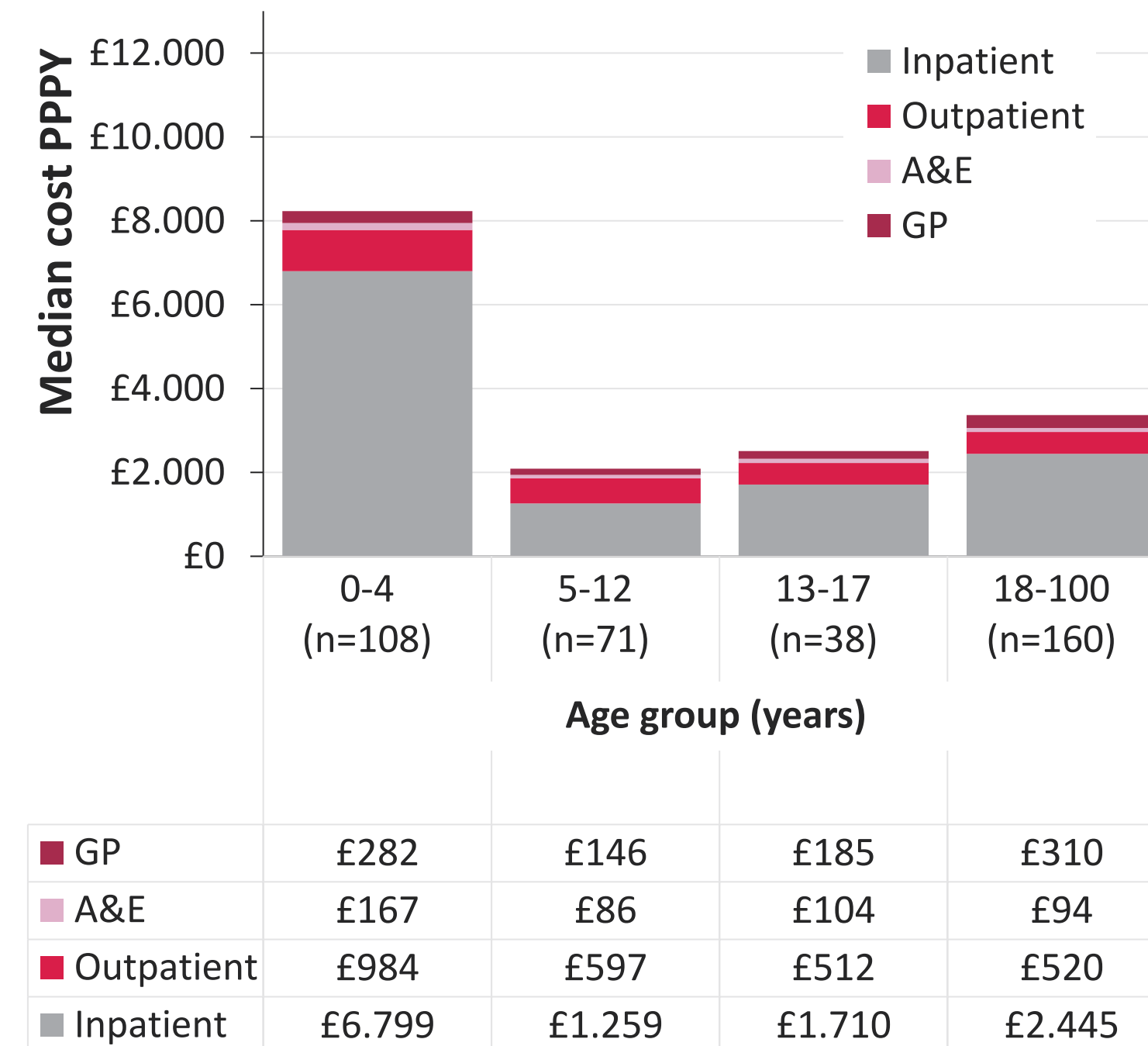


Figure 2. Median cost PPPY by age group and service for patients with MTM classified by the narrow definition

MTM narrow definition, 95th percentile costs PPPY (N=377)

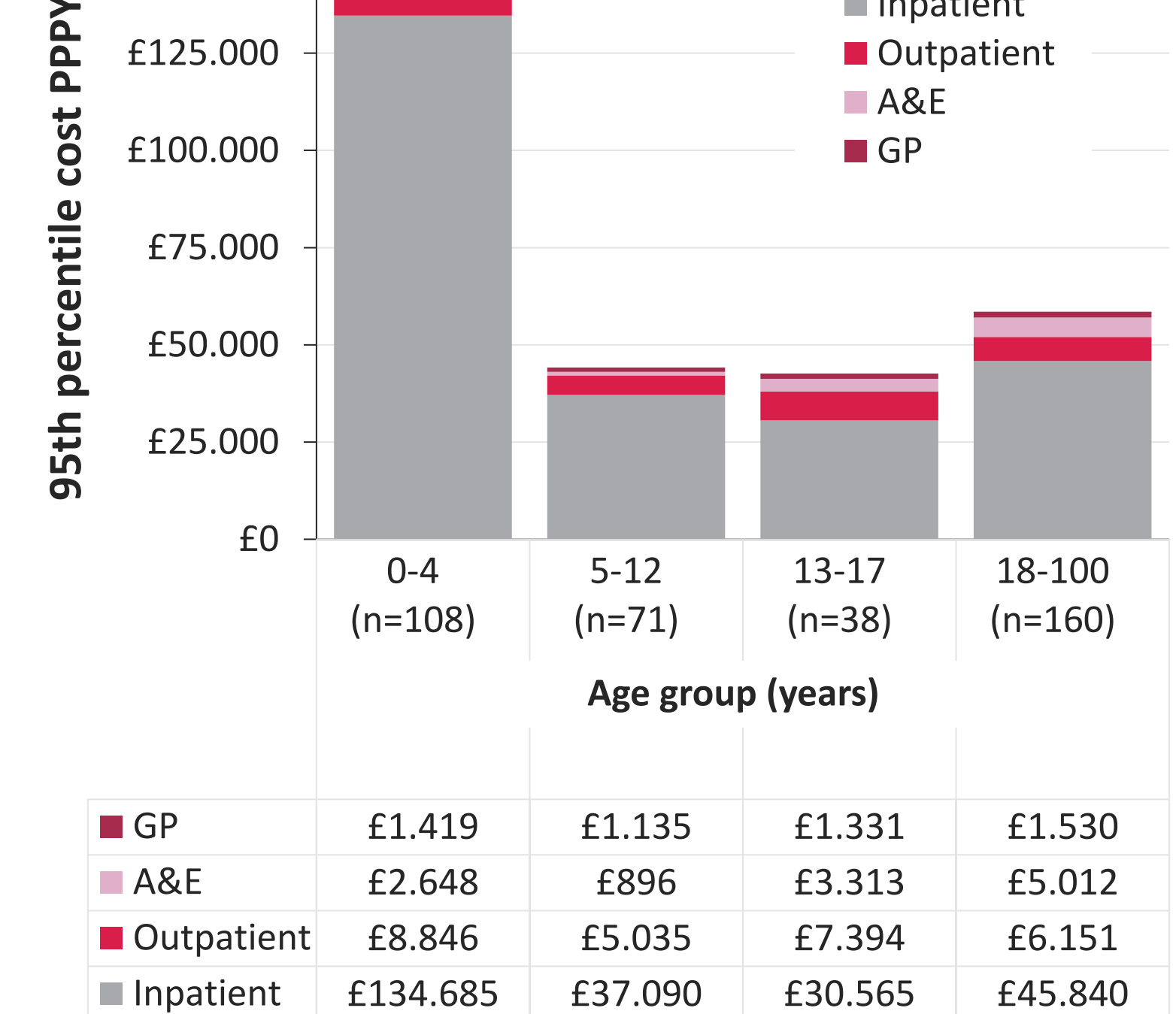


Figure 3. 95th percentile cost PPPY by age group and service for patients with MTM classified by the narrow definition

MTM broad definition, MEAN costs PPPY (N=4,140)

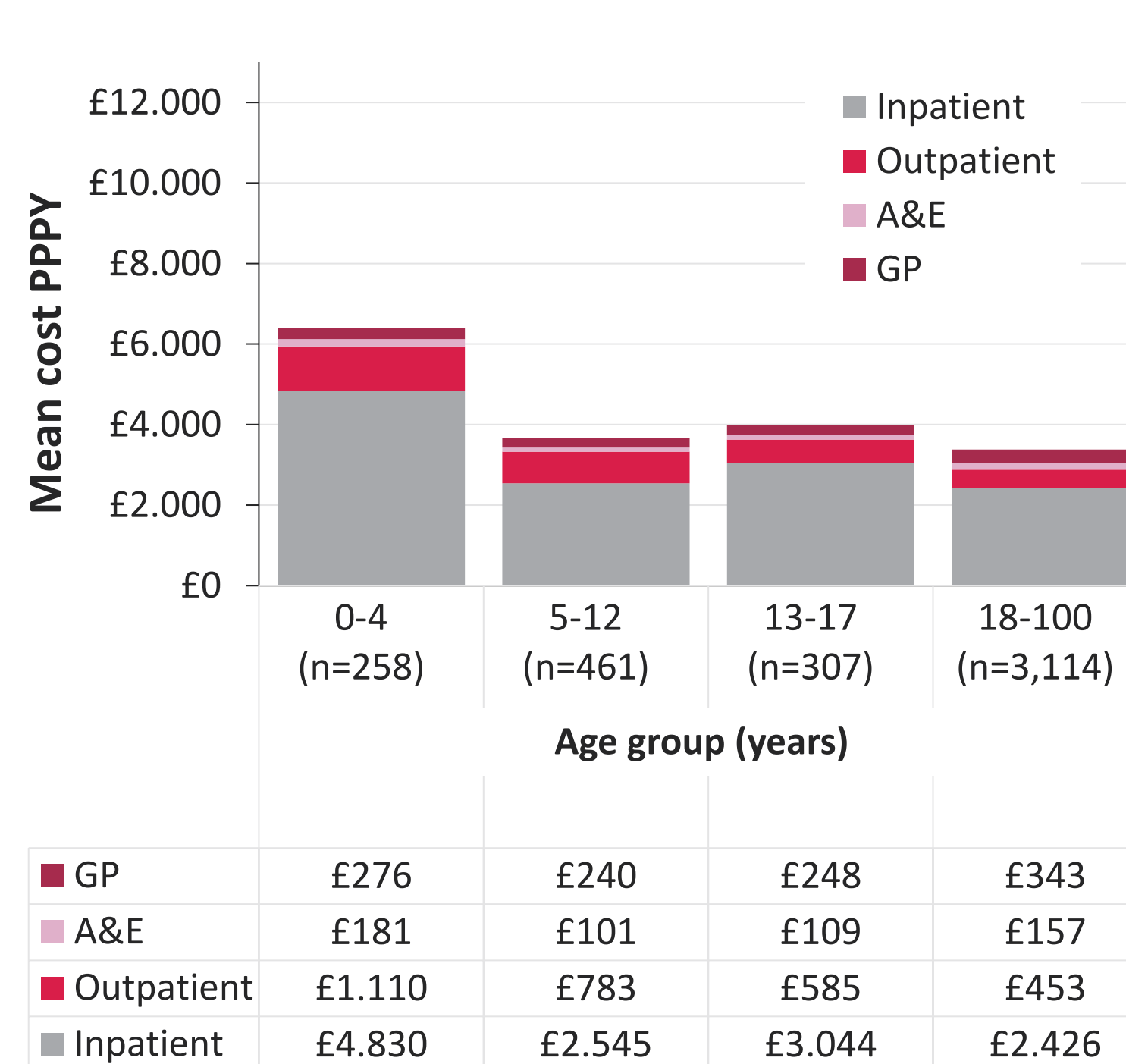


Figure 4. Mean cost PPPY by age group and service for patients with MTM classified by the broad definition

MTM broad definition, MEDIAN costs PPPY (N=4,140)

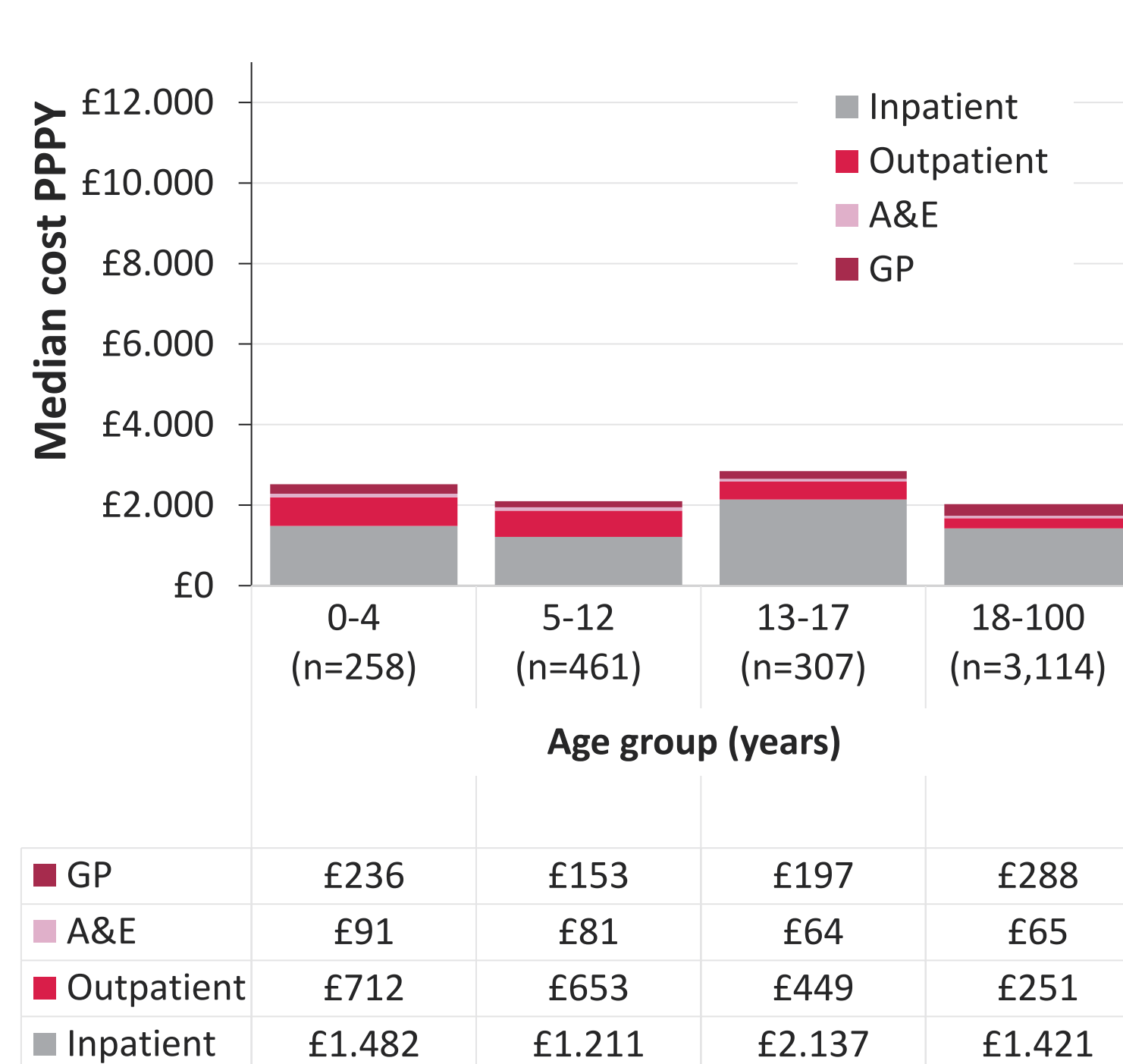


Figure 5. Median cost PPPY by age group and service for patients with MTM classified by the broad definition

MTM broad definition, 95th percentile costs PPPY (N=4,140)

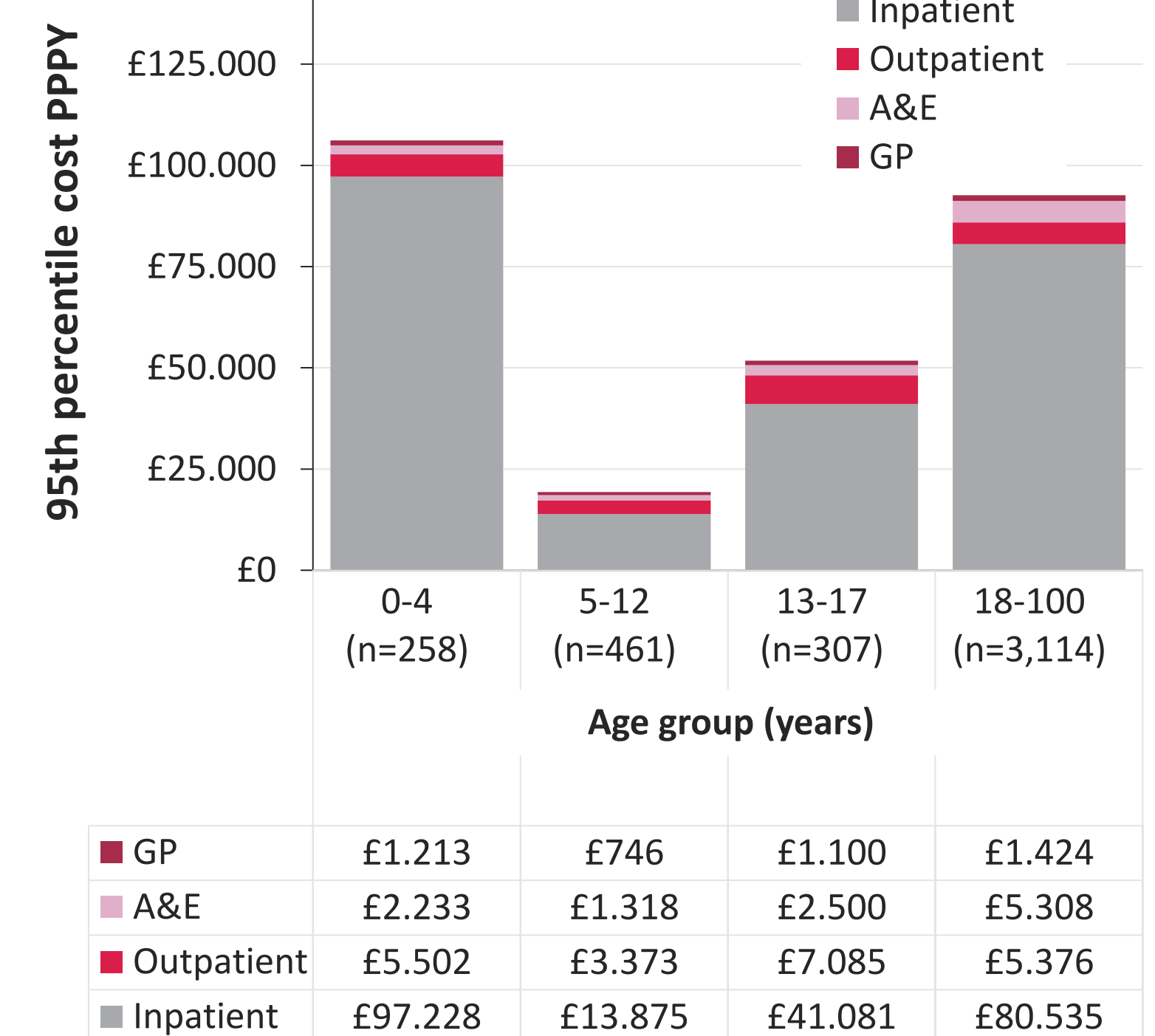


Figure 6. 95th percentile cost PPPY by age group and service for patients with MTM classified by the broad definition

## Summary

- The economic and disease burden of MTM on the healthcare system in England is substantial
- Under a broader perspective including e.g., home support, costs would be significantly higher
- Median costs for the 0- to 4-year age group for the MTM narrow definition, a category that is most likely to include XLMTM, are substantially greater than for older age groups in both the narrow- and broad-definition analyses
- Economic evaluations of MTM need to emphasise probabilistic sensitivity analyses to reflect the true potential economic burden of this condition

### ABBREVIATIONS

A&E, accident and emergency; CPRD, Clinical Practice Research Datalink; EMR, electronic medical records; GBP, British pound; GP, general practice; HCRU, healthcare resource utilization; HES, Hospital Episode Statistics; ICD-10, International Classification of Disease Tenth Revision; IQR, interquartile range; MTM, myotubular myopathies; NOS, not otherwise specified; PPPY, per patient per year; XLMTM, X-linked myotubular myopathy.

### ACKNOWLEDGEMENTS

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### REFERENCES

1. Beggs AH, et al. *Muscle Nerve* 2018;57:550–60. 2. Jungbluth H, et al. *Orphanet J Rare Dis* 2008;3:26. 3. Annoussamy M, et al. *Neurology* 2019;92: e1852–67. 4. Graham RJ, et al. *Arch Dis Child* 2020;105:332–38. 5. Amburgey K, et al. *Neurology* 2017;89:1355–64. 6. Sacks NC, et al. *J Manag Care Spec Pharm* 2021:1–8.