# Characterizing the economic burden associated with obstructive HCM: healthcare resource use and costs in England

# Faizel Osman,<sup>1</sup> Carla Zema,<sup>2</sup> Michael Hurst,<sup>3</sup> Belinda Sandler,<sup>3</sup> Florence Brellier,<sup>3</sup> Ovie Utuama,<sup>2</sup> Oksana Kirichek,<sup>4</sup> John Houghton,<sup>4</sup> Teresa Lemmer,<sup>3</sup> Maite Tome Esteban<sup>5</sup>

<sup>1</sup>Institute of Cardio-Metabolic Medicine, University Hospitals Coventry, UK/University of Warwick, Warwick Medical School, Coventry, UK; <sup>2</sup>Bristol Myers Squibb, Lawrenceville, NJ, USA; <sup>3</sup>Bristol Myers Squibb, Uxbridge, UK; <sup>4</sup>HEOR Ltd Health Economics & Outcomes Research Ltd, Cardiff, UK; <sup>5</sup>Cardiovascular CAG, St George's University Hospitals NHS Foundation Trust & St George's, University of London, London, UK

# Introduction

- Hypertrophic cardiomyopathy (HCM) is a chronic, progressive disease of the heart characterized by hypercontractility of the heart muscle, leading to left ventricular hypertrophy and cardiac dysfunction<sup>1,2</sup>
- HCM can be categorized as obstructive or non-obstructive based on the presence or absence of left ventricular outflow tract obstruction (LVOTO).<sup>3</sup> Approximately two-thirds of patients diagnosed with HCM in the UK are classified as having the obstructive form<sup>4</sup>
- Presence of LVOTO exacerbates HCM progression and is associated with significant symptom burden and increased mortality risk<sup>5</sup> • The severity of HCM symptoms can be clinically assessed using the New York Heart Association (NYHA) classification system, where higher NYHA classes are associated with greater clinical and symptom burden and impaired health-related quality of life<sup>6,7</sup> • The substantial clinical burden of obstructive HCM is likely to be associated with high healthcare resource use (HCRU) and significant medical costs

### NYHA class distribution

- At baseline, 966 (25.9%), 1264 (33.9%), 1407 (37.7%), and 93 (2.5%) patients were assigned to NYHA class I, II, III, and IV, respectively (Figure 1A)
- At the end of each patient's individual follow-up, the NYHA class distribution of the study population shifted from baseline to higher (worse) NYHA classes, with 216 (5.8%), 1744 (46.8%), 1638 (43.9%), and 132 (3.5%) patients assigned to NYHA class I, II, III, and IV, respectively
- During follow-up, patients spent the most time in NYHA classes I, II, or III, with a total of 1710 (8.8%), 8558 (44.3%),
- The total secondary care HCRU costs increased with higher NYHA class, from £2355 PPY (NYHA class I) to £5796 PPY (NYHA class IV) (Table 1)

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- Inpatient admissions (elective and non-elective) were the largest component of secondary care costs, followed by outpatient visits (Figure 3)
- For patients in NYHA class II-IV, non-elective inpatient admissions were a greater proportion of inpatient admissions than elective: 58%, 64%, and 74% for classes II, III, and IV, respectively (Figure 3). For NYHA class I, 44% were non-elective

# Objectives

• The objective of this study was to characterize the HCRU and related costs associated with obstructive HCM in England to provide insight into the relationship between disease severity and economic burden on healthcare systems to inform optimized disease management

# Methods

- This was an observational retrospective cohort study of adult patients diagnosed with obstructive HCM in routine clinical practice in England (between April 01, 2009 and October 30, 2020) using electronic health records (EHRs) from the primary care Clinical Practice Research Datalink (CPRD) GOLD and Aurum data sets linked to secondary care Hospital Episode Statistics (HES) databases
- All data linkage and de-duplication were performed by CPRD before data access, where unique patient identifiers were used • The Independent Scientific Advisory Committee (ISAC) approved the study protocol (ISAC application reference 21\_000342) on September 04, 2021 • Eligible patients were aged  $\geq$  18 years at index date with  $\geq$  1 year of follow-up data and with at least one of the following indications of obstructive HCM: any obstructive HCM diagnosis, any HCM diagnosis code with LVOTO, or any HCM diagnosis with septal reduction therapy • Patients were excluded if they had a record of any of the following conditions during the study period: hypertensive heart disease, aortic stenosis, athlete's heart, storage disease, Takotsubo cardiomyopathy, Fabry disease, Anderson-Fabry disease, Pompe's disease, or amyloidosis • Patients were assigned NYHA classifications based on their EHRs. When not documented in the EHRs, NYHA class was assigned at baseline and during follow-up using a stepwise algorithm based on recorded treatments and symptoms developed in collaboration with clinical experts in obstructive HCM • Inpatient costs were calculated using the HES healthcare resource groups (HRG) table to pull the total cost of the relevant inpatient visits using HRG currency codes. Elective/non-elective inpatient admissions and day cases were summarized

and 8289 (42.9%) PY, respectively (Figure 1B)

Figure 1. (A) NYHA class distribution of patients diagnosed with obstructive HCM at baseline and at end of each patient's individual follow-up; and (B) time spent in each NYHA class during follow-up



- The total secondary care CV-related test and procedure costs increased with higher NYHA class, from £468 PPY (NYHA class I) to £1435 PPY (NYHA class IV) (Table 1)
  - Most costs were due to implantable devices
  - (i.e. pacemakers, cardiac resynchronization therapy, and defibrillators) and ablation

### Figure 3. Secondary care resource costs PPY for patients with obstructive HCM, by NYHA classs



# Limitations

• Owing to the nature of retrospective data, this study has inherent limitations, including missing data and potential inaccuracies in coding and data entry • Linked data are only available for patients registered at GP practices in England who have agreed to the linkage scheme at CPRD. Although not all patients within the CPRD data set were eligible for linkage, the data are generally considered generalizable to the UK population • NYHA classification is not routinely captured in CPRD/HES data. The algorithm used to assign patients to NYHA class was predominantly based on treatment records and has not been fully validated. This approach is likely to miss the nuances of NYHA class assignment that a clinician would generally undertake, especially when considering variations that occur during hospitalizations • Owing to inconsistent coding of HCM in later stages of the disease when heart failure is also present, HCM-related costs could not be accurately estimated • Costs were calculated using 2020-2021 cost reports available at the time of analysis. Notably, 2021-2022 costs have increased substantially; therefore, the results underestimate the economic burden using more current costs

 All other unit costs were obtained from the national schedule of NHS costs annual report (2019-2020),<sup>8</sup> adjusted according to the Personal Social Services Research Unit (PSSRU) report of February 2021<sup>9</sup> • HCRU and associated costs were estimated per patient-year (PPY) and stratified by disease severity according to NYHA classification

### Economic burden

- Total HCRU costs PPY associated with the obstructive HCM cohort were £4386, where the majority (£3202) of costs were attributed to secondary care services
- The total HCRU costs PPY were greater for patients in higher NYHA classes, ranging from £3033 for NYHA class I to £7881 for NYHA class IV (Table 1)
- When stratifying by setting, the total primary care HCRU costs increased with higher NYHA class, from £209 PPY (NYHA class I) to £649 PPY (NYHA class IV) (Table 1)
- Most primary care HCRU costs were attributed to general practitioner (GP) consultations (Figure 2)

Table 1. Total HCRU costs for patients diagnosed with obstructive HCM, by NYHA class

	NYHA class			
Cost PPY (£)	I	II	111	IV
Primary care <sup>a</sup>	209.43	313.16	462.22	649.29
Secondary care	2355.26	2564.94	3790.56	5796.35
Tests and procedures	468.13	691.52	925.69	1435.07
Total cost PPY	3032.82	3569.62	5178.47	7880.71

<sup>a</sup>Primary care total cost includes the cost of GP, nurse, and telephone consultations.

### Figure 2. Primary care resource costs PPY for patients with obstructive HCM, by NYHA class

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# Conclusions

- The HCRU and costs of care for patients with obstructive HCM increased with higher (worse) NYHA class, including both primary and secondary care
- The health economic burden of obstructive HCM in England is considerable, particularly in patients with more severe disease

### Results

### Patient population

- A total of 3730 patients met the eligibility criteria for the obstructive HCM cohort, contributing 19,352 patient-years (PY)
- The cohort was 60.5% male (n = 2257) and the majority (80.8%) were of White ethnicity (n = 3013), with a mean age of 61.2 (standard deviation [SD]: 15.5) years
- The mean Charlson Comorbidity Index score was 2.96 (SD: 2.40)
- The mean follow-up time was 5.2 (SD: 3.0) years



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- This study was supported by Bristol Myers Squibb.
- All authors contributed to and approved the poster; writing and editorial assistance were provided by Chloe Salter and Robert Jenkins of HEOR Ltd, UK, and Kate Ward and Grant Womack of Oxford PharmaGenesis, Oxford, UK, funded by Bristol Myers Squibb.

### Disclosures

• Faizel Osman receives research grants from Abbott Medical, Boston Scientific, Bristol Myers Squibb, British Heart Foundation, Creavo Technologies, and Medtronic. Carla Zema is a contractor for Bristol Myers Squibb. Michael Hurst, Belinda Sandler, Florence Brellier, Ovie Utuama, and Teresa Lemmer are current employees of Bristol Myers Squibb and may own Bristol Myers Squibb stock or stock options. Oksana Kiricheck and John Houghton are employees of HEOR Ltd., which received funding from Bristol Myers Squibb to conduct this study. Maite Tome Esteban received consultancy fees from Bristol Myers Squibb and Cytokinetics.