Proactive detection of heart valve disease in community pharmacy using digital auscultation AI technology

An Economic Model

ENTER

January 2024

FOR HEALTHCARE LEADERS HSJ

Wilmington Healthcare

Introduction

This tool aims to help Integrated Care boards (ICBs) understand the financial implications, resource requirements, and comprehensive influence of establishing and operating an innovative proactive detection service for heart valve disease (HVD) in the community pharmacy setting.

Additionally, for commissioning considerations, it gauges the magnitude of the service needed based on population size.

The economic model presented in this tool is based on an evaluation of the Farnborough Primary Care Network (PCN) Pilot Project that took place from June 2022 – January 2023.[1]

Why heart valve disease?

HVD is common, with approximately 5% of adults aged 65 years or greater affected by aortic stenosis (AS), one form of HVD.[2]

AS, the most common form of HVD, carries a worse prognosis than many cancers,[2] though many patients remain undiagnosed and untreated.[3,4]

Detection of HVD is an NHS priority listed in the NHS Long Term Plan,[5] all systems in England are required to make improvements over the next six to seven years.

Innovative ways of detecting HVD should be embraced for the NHS to meet its objectives and proactively detect patients with HVD so that they can be diagnosed and treated in a timely manner.

Challenges in HVD

HVD can be poorly recognised by HCPs and patients because common symptoms, like breathlessness and reduced exercise tolerance, may be attributed to advancing age.

The first step in the detection of HVD requires chest auscultation, which often is conducted by GPs to determine if a patient has a heart murmur. However, with a reduction of face-to-face GP appointments during and since the Covid-19 pandemic, coupled with increased pressure on GP services, opportunities for auscultation have become more difficult.

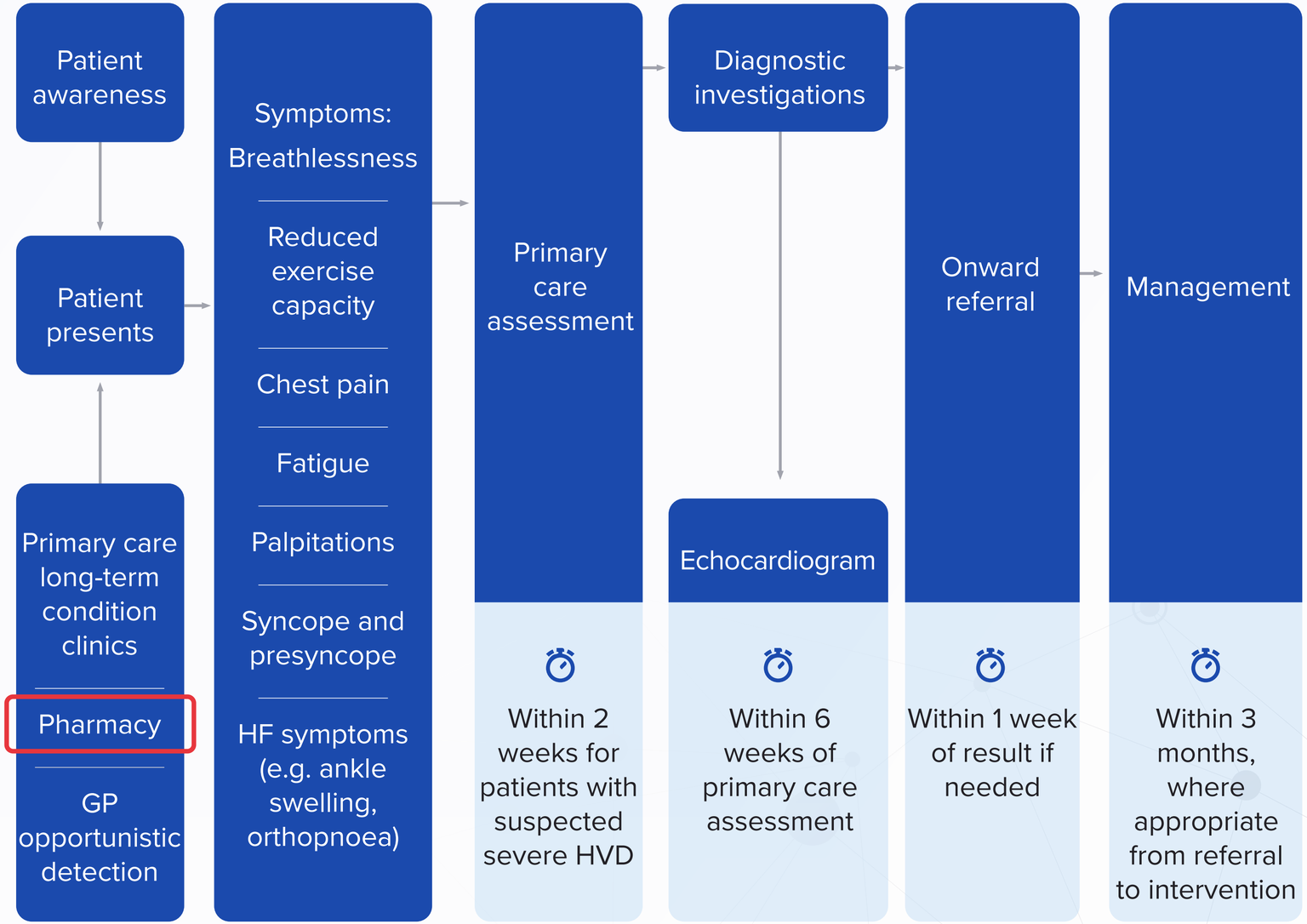
If a patient is found to have a heart murmur, they are then referred to echocardiography for diagnosis. However, capacity in echocardiography has been a notable challenge; most notably with retaining, recruiting, and training echocardiography staff, leading to increased pressures on the existing workforce and significant backlogs.

An expert group developed an exemplar pathway to support detection of HVD in the community (2022).[6]

Read the full community HVD pathway here[6]

Find the community HVD pathway report here

The Farnborough Pilot Project provided evidence to support the pharmacy entry point of the pathway.[1]



What did we learn from the Farnborough PCN Pilot Project?

Over the same time period, the community pharmacist made more non-trivial HVD referrals to the community echo service than GP practices in the area – the conventional referral route.

During the Farnborough PCN Pilot Project,[1] a community pharmacist was trained to use a digital stethoscope with auscultation AI technology to detect heart murmurs. Patients who were found to have a heart murmur were referred to a community echocardiography (echo) service to confirm diagnosis, determine HVD severity, and be forwarded for onward treatment if appropriate.

Read the full Pilot Project report here

Patients referred by the community pharmacist versus GP practices in Farnborough PCN by echocardiography result[1]

Referrals to community echocardiography	Community pharmacist	GP practices
Total	39	24
Moderate/severe HVD	8 (21%)	2 (8%)
Mild HVD	9 (23%)	8 (33%)
'Normal' or 'trivial HVD'	22 (56%)	14 (58%)

70%
more referrals for non-trivial HVD by pharmacy compared to GP practices (17 vs 10 patients)

Case studies

On two occasions, the community pharmacist detected a significant murmur and was able to rapidly share the patient's audio recording of the auscultation with the GP with special interest in cardiology (GPwSI) running the community echocardiography clinic. Upon hearing the digital auscultation audio file, and prior to having an echo or seeing the patient in person, the GPwSI was able to detect significant severe symptomatic HVD and referred the patients to A&E for urgent treatment.

Upscaling the pilot

In May 2023, an expert group was convened to discuss the potential for upscaling the Farnbourgh Pilot Project more widely in England.

The group agreed that an extended community pharmacy role, which is already established in areas like hypertension and atrial fibrillation, should be pursued for murmur detection – initially by first expanding the Farnborough Pilot Project and then for it to be commissioned in the future by Integrated Care Boards (ICBs) in collaboration with Cardiac Clinical Networks (CCNs).

The NHS Long Term Plan requires all ICBs in England to make meaningful progress on diagnosing HVD. This means taking action to find the patients who have undetected HVD.

For ICBs to achieve this, developing new strategies to improve murmur detection, like this pilot project, will be crucial. Championing initiatives that create change should be a priority for patient organisations and CCNs.

Read the resulting white paper here

Pharmacy leadership were in unanimous support of the Farnborough Pilot Project, agreeing that community detection of HVD was well served in community pharmacy, and they were encouraging of a wider rollout of the initiative, noting that it should be commissioned.[7]

Pharmacy leadership recognised that patients accepted and were comfortable with the service, which fully aligns with other enhanced services that community pharmacy now offer. They acknowledged that community pharmacy has the workforce and skills to deliver this service.[7]

Economic model

Setting the scene

To help ICBs understand the resource required to run a proactive HVD detection service in community pharmacy, a cost model was developed based on benchmarks from the Farnborough pilot project.[1]

The model uses a 'model ICB', which assumes a population of 100,000 patients aged 65 years or greater. Different ICBs can therefore determine the resource required based on their population of those aged 65 years or greater.

While proactive detection of HVD in community pharmacy services holds the potential to identify all forms of HVD, our approach has primarily relied on prevalence and incidence estimations for severe symptomatic AS.

This choice is driven by the availability of robust data for this specific type of HVD, whereas other forms currently lack sufficient data integrity. However, it's important to note that the impact of the service is therefore underestimated, as patients with other forms of HVD will also be proactively detected.

The yearly incidence of severe symptomatic AS for a population of 100,000 patients aged 65 years or greater.*

160 patients

For a population of 100,000 patients aged 65 years or greater, the yearly incidence gap of severe symptomatic AS (53%)*.

85 patients

In order to close the yearly incidence gap, the number of patients required to participate in the service.**

899 patients

* See 'Gap analysis methodology' on slide 17 to see how this figure was calculated
**Based on the assumption that 45% of patients who participate in the scheme will need a referral and of these 21% will be diagnosed with moderate or severe HVD (using benchmarks from the report "Increasing detection of heart valve disease in Farnborough PCN using auscultation AI in the community pharmacy setting" (March 2023)

SETTING THE SCENE
COSTS BREAKDOWN
COSTS OVER 5 YEARS
COST COMPARISON
RESOURCE IMPLICATIONS
ICS MULTIPLIER

Costs breakdown

Breakdown of the fixed costs and variable costs required to set up and run the scheme in the 'model ICB' with a patient population of 100,000 people aged 65 years or greater.

IF 899 Patients **Are required to participate in the service.**

THEN 10 Community Pharmacies **Are estimated to be required to deliver the service.***

Breakdown of Costs	Upper Estimates			Lower Estimates		
	Unit Cost	Units**	Total Cost	Unit Cost	Units**	Total Cost
Fixed costs						
Littman digital stethoscope	£400	10	£4,000	£300	10	£3,000
iPad	£500	10	£5,000	£350	10	£3,500
Couch	£800	10	£8,000	£300	10	£3,000
Total Fixed costs			£17,000			£9,500
Variable costs (per annum)						
eMurmur® technology	£12	899	£10,788	£12	899	£10,788
Service cost per patient***	£35	899	£31,465	£25	899	£22,475
Echos****	£125	405	£50,625	£125	405	£50,625
Cost of interpreting each echo	£150	405	£60,750	£150	405	£60,750
Staff training costs*****	£1,500	20	£30,000	£1,500	20	£30,000
Total Variable Costs (per annum)			£183,628			£174,638

*Based on the Farnborough Pilot Project where one pharmacy was able to serve a population of approximately 10,000 people aged 65 years or greater
**When looking at fixed costs, number of units refers to the number of community pharmacies; when looking at variable costs, number of units refers to either number of patients or number of staff
***i.e., the payment received by the pharmacy per patient participating
****Based on the assumption that 45% of patients who participate in the scheme will need a referral for an echo (using benchmarks from the report "Increasing detection of heart valve disease in Farnborough PCN using auscultation AI in the community pharmacy setting" (March 2023))
*****Based on half a day of training per staff member

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Costs over 5 years

We modeled the costs associated with running the service over 5 years, and the annual average cost for a 'model ICB' over those 5 years.

These costs can be used by ICBs to better estimate the resource required based on their population aged 65 years or greater.

£208 **Cost per patient participating in the service.***

£2,200 **Cost per patient detected with moderate or severe HVD.****

Costs Over a 5-year Programme	Upper Estimates	Lower Estimates
Fixed costs	£17,000	£9,500
Variable Costs (over 5 years)	£918,140	£873,190
Total Costs (over 5 years)	£935,140	£882,690
Annual Average	£187,028	£176,538

*Cost per patient based on upper estimates
**This is under the assumption that all of the purchases under fixed costs will last 5 years without the need for replacement

Cost comparison

Patients with HVD must first have their condition detected and diagnosed before they can be treated. Without treatment, patients with severe symptomatic AS may deteriorate rapidly.

Based on historic trends in HES data, we estimate that approximately **20%*** of patients who have untreated severe symptomatic AS will develop heart failure, which has substantial associated costs.

From 'Malcolm's story'[8] we estimate the cost to the system for a patient developing heart failure is **£41,606.****

For a population of **100,000** patients aged **65 years** or greater, we estimate there are **85 patients** who have undetected and untreated severe symptomatic AS.

If **20%** of these patients develop heart failure, then the cost to the 'model ICB' would be **£707,302.**

In comparison, the cost of detecting HVD in a 'model ICB' based on upper estimates is relatively low - only **£187,028.**

Thus, community pharmacy HVD detection has the potential to provide cost savings of **£520,274** per year to a 'model ICB'.

*Based on HES data presented in the Edwards AS Calculator we estimate that 20% of patients diagnosed with AS will go on to develop heart failure[4]
**These costs are the total costs of treating a single patient with AS who develops heart failure over an entire 5-year period, as presented in "Malcolm's story"[8]

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Resource implications

The resource required to run a service for a 'model ICB', which would proactively identify all patients with undetected severe symptomatic aortic stenosis is shown below.

20
Pharmacists

Required to service a population of 100,000 people aged 65 years or greater.*

0.56
Patients per day

Would need to be seen on average by each pharmacist.**

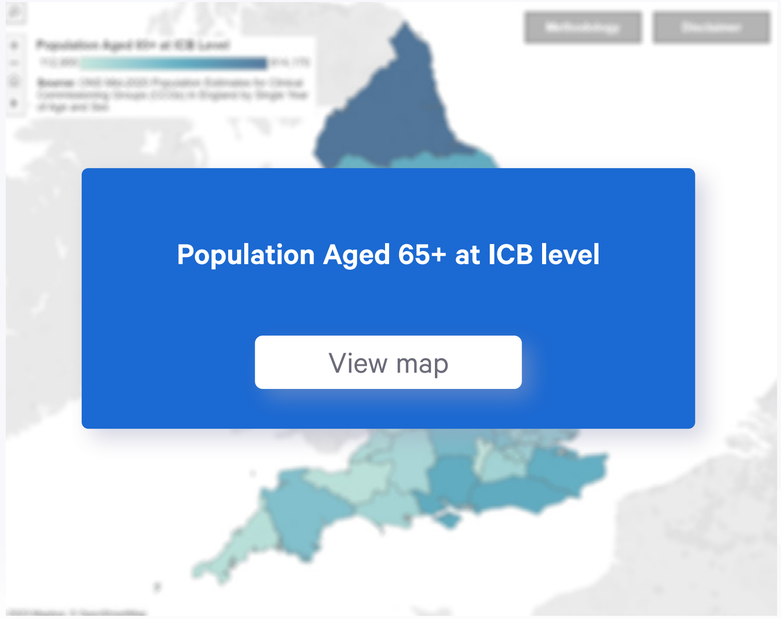
80
Working days

Would be needed for 899 patients to participate in the scheme each year with the resources outlined.***

*Based on the case study of Farnborough PCN where two pharmacists serve a population of approximately 10,000 people aged 65 years or greater (though only one pharmacist implemented the service during the pilot project itself)[1]
**Based on sample data from Farnborough PCN (March 2023) which showed that 86 patients were seen over a period of 154 working days[1]
***Based on a 260-day working year[1]

ICB multiplier

The presented model and resulting figures are based on a population aged 65 years or greater of 100,000 people. The accompanying map on this page serves as a reference, showing the scaling factors to be applied to the presented values in the model so that it adjusts for population size in any ICB catchment area.*



As an example, when examining NHS Dorset ICB, you would employ a multiplier of 2 for all output values in the model. So where 899 patients would need to participate in the service for a population of 100,000 people aged 65 years or greater, 1,788 would need to participate in NHS Dorset ICB in order to close the yearly incidence gap.**

*Based on ONS Mid-2020 Population Estimates for Clinical Commissioning Groups (CCGs) in England by Single Year of Age and Sex[9]
**The national level 53% incidence gap was used throughout this model, but it's important to note that this gap differs across ICBs – see Gap analysis methodology for details on how the incidence gap was calculated

Supporting Information

DATA TABLES

ICB MULTIPLIER (1)

ICB MULTIPLIER (2)

GAP ANALYSIS METHODOLOGY

ABBREVIATIONS

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ICB Multiplier (1)[9]

The model is based on an ICB with a population aged 65 years or greater of 100,000 people. This table shows how much to multiply the total values by depending on which ICB is being analysed.

ICB Name	Aged 65 years or greater	Multiplier
NHS BATH AND NORTH EAST SOMERSET, SWINDON AND WILTSHIRE INTEGRATED CARE BOARD	185,319	1.9
NHS BEDFORDSHIRE, LUTON AND MILTON KEYNES INTEGRATED CARE BOARD	151,511	1.5
NHS BIRMINGHAM AND SOLIHULL INTEGRATED CARE BOARD	178,499	1.8
NHS BLACK COUNTRY INTEGRATED CARE BOARD	225,347	2.3
NHS BRISTOL, NORTH SOMERSET AND SOUTH GLOUCESTERSHIRE INTEGRATED CARE BOARD	166,686	1.7
NHS BUCKINGHAMSHIRE, OXFORDSHIRE AND BERKSHIRE WEST INTEGRATED CARE BOARD	313,750	3.1
NHS CAMBRIDGESHIRE AND PETERBOROUGH INTEGRATED CARE BOARD	166,201	1.7
NHS CHESHIRE AND MERSEYSIDE INTEGRATED CARE BOARD	502,510	5
NHS CORNWALL AND THE ISLES OF SCILLY INTEGRATED CARE BOARD	145,457	1.5
NHS COVENTRY AND WARWICKSHIRE INTEGRATED CARE BOARD	171,698	1.7
NHS DERBY AND DERBYSHIRE INTEGRATED CARE BOARD	212,694	2.1
NHS DEVON INTEGRATED CARE BOARD	293,939	2.9
NHS DORSET INTEGRATED CARE BOARD	198,608	2
NHS FRIMLEY INTEGRATED CARE BOARD	121,705	1.2
NHS GLOUCESTERSHIRE INTEGRATED CARE BOARD	139,420	1.4
NHS GREATER MANCHESTER INTEGRATED CARE BOARD	459,044	4.6
NHS HAMPSHIRE AND ISLE OF WIGHT INTEGRATED CARE BOARD	381,042	3.8
NHS HEREFORDSHIRE AND WORCESTERSHIRE INTEGRATED CARE BOARD	185,897	1.9
NHS HERTFORDSHIRE AND WEST ESSEX INTEGRATED CARE BOARD	259,333	2.6
NHS HUMBER AND NORTH YORKSHIRE INTEGRATED CARE BOARD	378,534	3.8

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ICB MULTIPLIER (2)

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ICB Multiplier (2)[9]

ICB Name	Aged 65 years or greater	Multiplier
NHS KENT AND MEDWAY INTEGRATED CARE BOARD	368,048	3.7
NHS LANCASHIRE AND SOUTH CUMBRIA INTEGRATED CARE BOARD	354,693	3.5
NHS LEICESTER, LEICESTERSHIRE AND RUTLAND INTEGRATED CARE BOARD	200,622	2
NHS LINCOLNSHIRE INTEGRATED CARE BOARD	182,278	1.8
NHS MID AND SOUTH ESSEX INTEGRATED CARE BOARD	233,986	2.3
NHS NORFOLK AND WAVENEY INTEGRATED CARE BOARD	257,855	2.6
NHS NORTH CENTRAL LONDON INTEGRATED CARE BOARD	187,068	1.9
NHS NORTH EAST AND NORTH CUMBRIA INTEGRATED CARE BOARD	614,170	6.1
NHS NORTH EAST LONDON INTEGRATED CARE BOARD	209,887	2.1
NHS NORTH WEST LONDON INTEGRATED CARE BOARD	284,653	2.8
NHS NORTHAMPTONSHIRE INTEGRATED CARE BOARD	133,984	1.3
NHS NOTTINGHAM AND NOTTINGHAMSHIRE INTEGRATED CARE BOARD	214,211	2.1
NHS SHROPSHIRE, TELFORD AND WREKIN INTEGRATED CARE BOARD	112,955	1.1
NHS SOMERSET INTEGRATED CARE BOARD	141,969	1.4
NHS SOUTH EAST LONDON INTEGRATED CARE BOARD	215,183	2.2
NHS SOUTH WEST LONDON INTEGRATED CARE BOARD	201,662	2
NHS SOUTH YORKSHIRE INTEGRATED CARE BOARD	256,086	2.6
NHS STAFFORDSHIRE AND STOKE-ON-TRENT INTEGRATED CARE BOARD	238,605	2.4
NHS SUFFOLK AND NORTH EAST ESSEX INTEGRATED CARE BOARD	227,093	2.3
NHS SURREY HEARTLANDS INTEGRATED CARE BOARD	201,301	2
NHS SUSSEX INTEGRATED CARE BOARD	384,576	3.8
NHS WEST YORKSHIRE INTEGRATED CARE BOARD	405,940	4.1

Gap analysis methodology

Estimated Incidence of Severe Symptomatic AS, Mid-2017 to Mid-2020

AS incidence has been estimated by applying the age-specific estimates of severe AS incidence from the report by Strange, G., Scalia, G.M., Playford, D. et al.[3] to ONS Mid-Year Population Estimates.[9] Based on the report, it is assumed that 68.3% of severe AS patients will be symptomatic (the remaining patients will be asymptomatic). From these calculations, an overall incidence rate of 0.16% (16,812 patients) for the patient population in England aged 65+ has been estimated.

Gap Between Estimated Incidence of Severe Symptomatic AS and Patients Treated with TAVI or sAVR

The gap is the difference between the estimated incidence of severe symptomatic AS within the population aged 65+ and the number of patients treated with TAVI or sAVR in England. Using Hospital Episode Statistics, the number of patients who have had an inpatient spell with a diagnosis of AS between 1st April 2017 and 31st March 2022 and have subsequently had a TAVI or sAVR procedure (either within the same inpatient spell or in a subsequent spell) has been calculated as 39,710 over the entire 5-year period. This works out as 7,940 patients treated per year (with rounding applied).

Based on this data, the gap between the estimated incidence of severe symptomatic AS and patients treated with TAVI or sAVR is 8,872 patients in England, leading to an estimated undiagnosed/untreated rate of 53%.

The gap is calculated as an annual average and is also extrapolated to show an estimated value over 5 years.

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Calculations/Workings

Estimated incidence of severe symptomatic AS

- Yearly incidence of severe symptomatic AS = [patient population aged 65+] * [incidence rate of 0.16%]
- With an estimated population of 100,000 aged over 65:
  - Yearly incidence of severe symptomatic AS = 100,000 * 0.16% = 160 patients

Estimated gap in AS incidence and treatment

- Estimated gap in AS incidence and treatment = [Yearly incidence of severe symptomatic AS] * [undiagnosed/untreated rate of 53%]
- With an estimated yearly incidence of severe symptomatic AS of 160:
  - Estimated gap in AS incidence and treatment = 160 * 53% = 89 patients

Number of patients required to participate in the scheme in order to close the yearly incidence gap

- Number of patients required to participate in the scheme* = [Estimated gap in AS incidence and treatment] / [rate of referral of 45%] / [rate of diagnosis of 21%]
- With an estimated gap in AS incidence and treatment of 89 patients:
  - Number of patients required to participate in the scheme = 89 / 45% / 21% = 899 patients

Resources

f patients who participate in the scheme will need a referral and of these 21% will be diagnosed with moderate or severe HVD (using
ng detection of heart valve disease in Farnborough PCN using auscultation AI in the community pharmacy setting" (March 2023)

Abbreviations

AI	Artificial intelligence
AS	Aortic stenosis
A&E	Accident and emergency
CCG	Clinical commissioning group
CCN	Cardiac Clinical Networks
Echo	Echocardiography
GP	General practitioner
GPwSI	General Practitioner with special interest
HCP	Healthcare professional
HES	Hospital Episode Statistics
HVD	Heart valve disease
ICB	Integrated Care Board
ICS	Integrated Care System
NHS	National Health Service
PCN	Primary Care Network
sAVR	Surgical aortic valve replacement
TAVI	Transcatheter aortic valve implantation

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References

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4. ICD-10 codes, terms and text © World Health Organization, 1992-2024
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