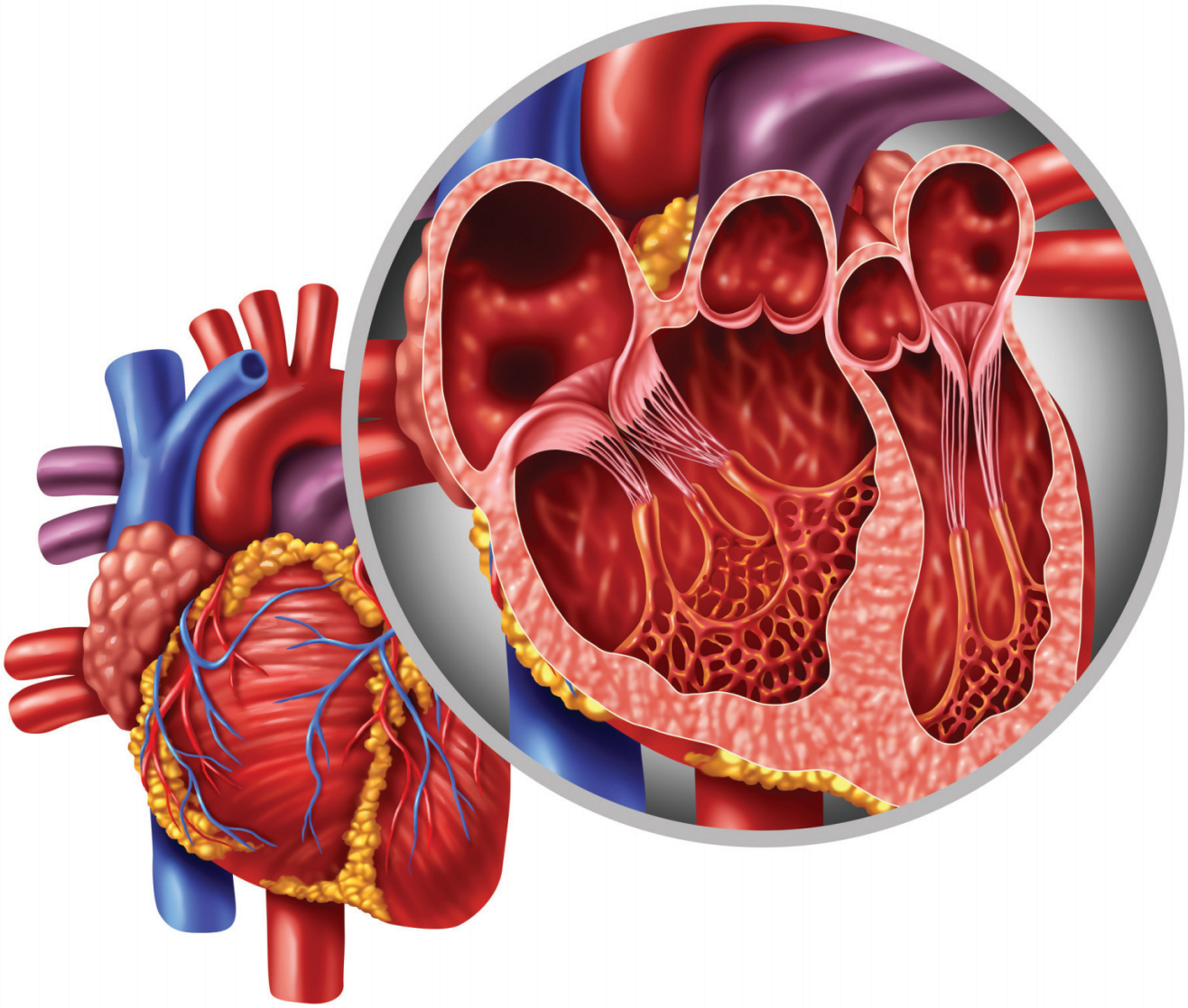

Network based care for Heart Valve Disease

Endorsed by the British Cardiovascular Society and Primary Care Cardiovascular Society

British Cardiovascular Society

Primary Care Cardiovascular Society

Driving primary care to deliver the best in cardiovascular health

April 2020

British Heart Valve Society

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A service framework for the care of patients with heart valve disease

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British Heart Valve Society

Authorship

The British Heart Valve Society was founded in 2010 to improve the care of patients with heart valve disease with a multidisciplinary approach through recommendations, research, and education.

It has published national recommendations for specialist heart valve clinics, heart valve centres, endocarditis services, and the community detection of valve disease.

This document extends this programme to the organization of a network of care for heart valve disease.

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Abbreviations

CT	Computerised tomography
DGH	District general hospital
HVD	Heart valve disease
IE	Infective endocarditis
INR	International normalised ratio
IT	Information technology
MDT	Multidisciplinary team
PET	Positron emission tomography
TAVI	Transcatheter aortic valve implantation
TOE	Transoesophageal echocardiography

Introduction

What is heart valve disease?

- Heart valve disease (HVD) means that one or more heart valves leak, open incompletely, or both.
- This can be caused by abnormalities of the valve as a result of age-related degeneration, congenital disease or damage from infection. Secondary valve problems occur as a result of stretching of the heart chambers to which the valves are attached.

Why is heart valve disease important?

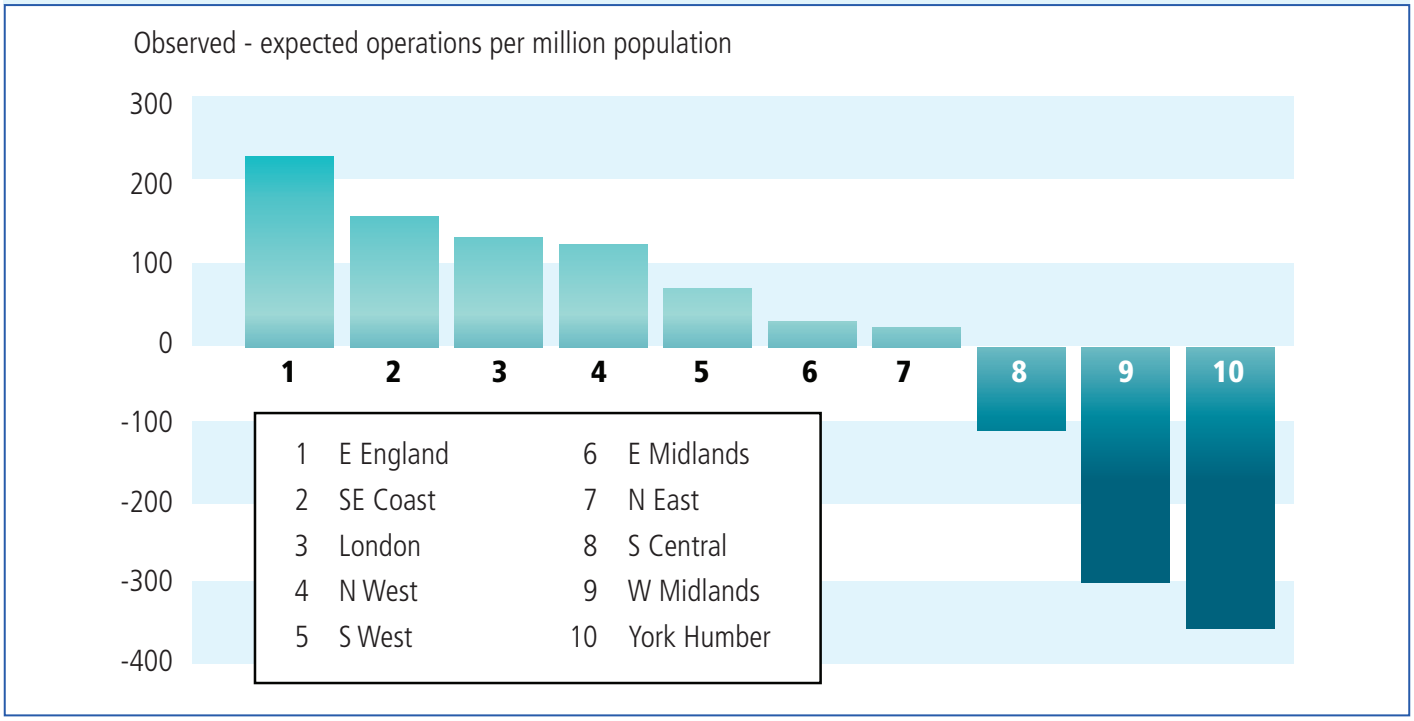
- HVD is increasing in incidence and is widely regarded as a developing epidemic.[1] The number of patients with heart valve disease is predicted to double by 2046[2]. This will have a major impact on individuals and their families, on society and on the National Health Service.
- Severe HVD can cause shortness of breath or chest pain. If untreated, it leads to heart failure and death, which may be sudden.

The case for change in service delivery for HVD

- Significant limitations exist in the provision of care for HVD in the UK at all steps:[3] detection; management by a cardiologist with competencies to judge the optimal timing for intervention; and referral to the appropriate surgeon or interventional cardiologist.
- There are problems recording and registering HVD in general practices and criteria for monitoring in the community or referring to a valve clinic are not clear.
- Guidelines for the management of patients with HVD already exist but they are not uniformly applied[4] which leads to:
  - Unwarranted variation and inequalities in care for patients with HVD[3,5] for example in access to surgery for aortic stenosis *[Figure 1]*
  - Unnecessary complications including heart failure and death
  - Late presentation which increases the risk of surgery and limits recovery after surgery

Figure 1. Inequitable access to aortic valve replacement surgery

A comparison of rates of aortic valve replacement in the UK against estimated need found a variance between observed and expected ranging between – 356 and +230. (Drawn from the latest data available, from 2005 to 2008 in reference (5)



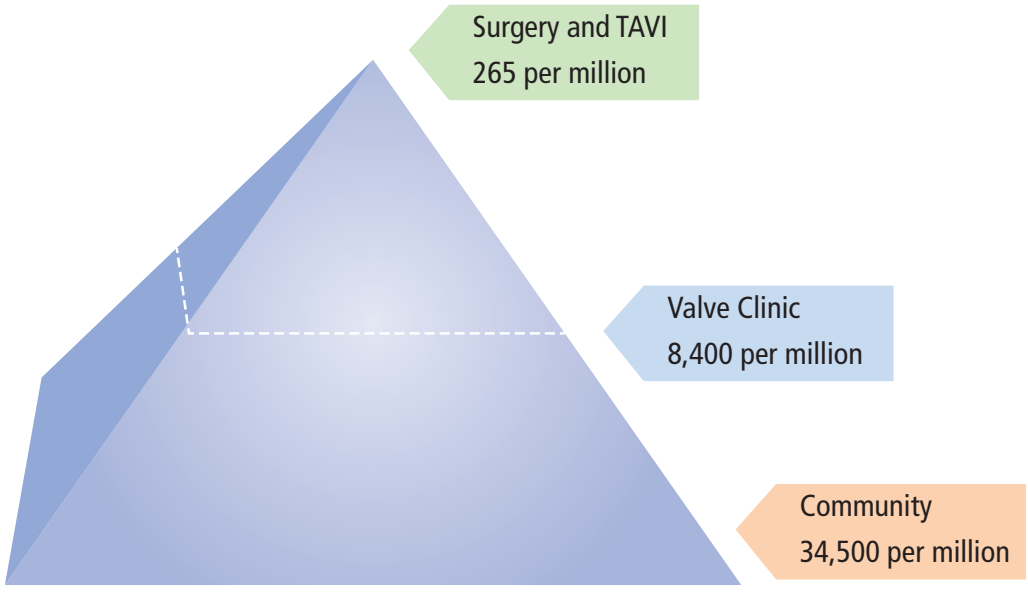
- The service is fragmented with duplication and inadequate coordination.
- There are many aspects of care which require specialist competencies in valve disease:
  - Evolving indications for early intervention
  - Choice of valve type in younger patients
  - Improved risk stratification tools to guide complex decision making
  - Management of frail, multimorbid patients
  - The assessment and management of moderate disease, particularly aortic stenosis, since the severity may be underestimated and the disease may not have a benign prognosis
- Costs are increasing, principally as a result of newer interventional procedures like transcatheter aortic valve implantation (TAVI) and these dominate governmental discussions. However, most patients are initially managed with surveillance, often for many years *[Figure 2]*[4], and receive insufficient attention.

Where does care for heart valve disease occur?

- Early detection occurs principally in the community[6] but also at other points of initial referral including medical outpatient clinics and surgical pre-admission clinics.
- Patients with moderate or severe valve disease are followed in a general or specialist outpatient clinic located in, based in, or supervised from, a district general hospital (DGH) or cardiac centre[3,7] until the optimal time for intervention. After initial assessment or discussion with the cardiologist supervising the valve clinic, some cases could reasonably be followed up in community clinics provided the necessary competencies and processes as described in this document are in place.
- Intervention occurs in a heart valve centre.[8,9]
- The empowered and engaged patient is a key to seamless care since they are inevitably present at every point of delivery.
- Patients with HVD are best managed in a network-based system *[Figure 3]* involving a multidisciplinary team of specialists.

Figure 2. Frequency of valve disease in the community, in valve clinics and receiving intervention

Calculations from reference 4



The Valve Disease Pyramid

Figure 3. The valve care network

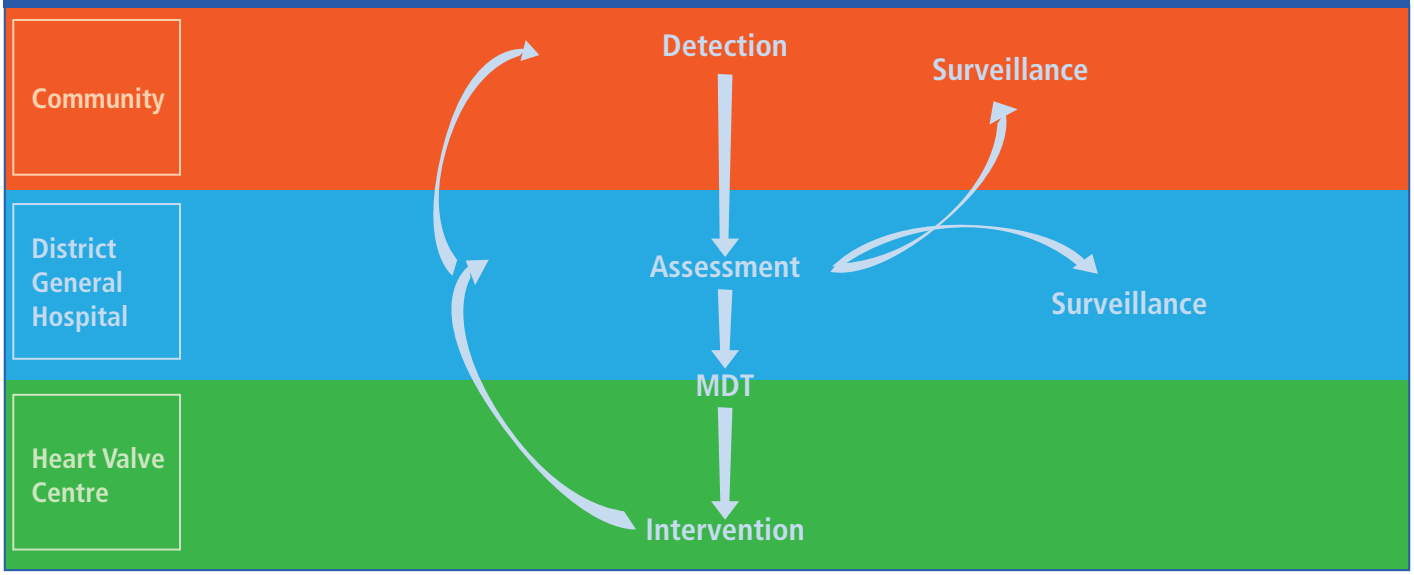


Figure 4. Summary of components of the heart valve network

Component 1: Recognition of HVD	• To improve early detection • Referral of patients with significant HVD to a heart valve clinic
Component 2: Monitoring of people with HVD	• To monitor all patients with moderate or severe HVD in a heart valve clinic • To determine the correct timing of intervention • To determine mode of intervention and refer to the appropriate service at the heart valve centre • To educate and inform patients
Component 3: Heart valve centre standards	• To ensure that efficient referral pathways exist for patients with symptomatic or severe HVD to a heart valve centre • To provide a collaborative, patient-centred heart team decision-making process. • To ensure heart valve centres achieve optimal outcomes by adequate interventional volumes, facilities and processes
Component 4: Inpatient care of people with HVD	• To ensure that all patients admitted with complications of HVD are assessed and managed by a healthcare professional with competencies in HVD
Component 5: Care of patients after valve intervention	• To ensure that patients after valve intervention receive rehabilitation and appropriate post-operative care and monitoring of their valve intervention
Component 6: HVD and Endocarditis	• To ensure necessary steps are taken to reduce the risk of patients with HVD developing infective endocarditis (IE) • To ensure that patients with or without prior HVD who develop IE are treated to a consistent high standard to reduce morbidity and mortality

Key principles of the service framework for heart valve disease

- To circumvent barriers between the community, DGH and cardiac centre by developing a network approach to the delivery of care.
- To position the patient at the centre of organizational concerns.
- To ensure that the same quality of care can be delivered wherever an individual patient presents.

Components of the heart valve network

These are summarized in Figure 4

Component 1: Recognition of heart valve disease

Aims:

1. To improve early detection.
2. To refer patients with significant HVD to a heart valve clinic.

Background:

- HVD is increasing in prevalence.
- Certain patient groups are particularly at risk, especially the elderly.
- Approximately half of patients with significant HVD are not detected.[2]
- Mild HVD is very common in the elderly and should not be over-diagnosed because of the risk of causing health anxiety.
- Early detection of patients with moderate or severe HVD and appropriate referral for specialist assessment can reduce morbidity and mortality.

Recommendations:

Deliver guidance to general practitioners

A system of guidance should be agreed nationally but is also part of the scope of heart valve clinics:

- Clinical presentation of HVD
- Indications for echocardiography.
- How to code echocardiography reports.
- Principles of management for HVD.
- Frequency of monitoring of patients with HVD.
- Criteria for referral to a hospital heart valve clinic.

Promote auscultation in primary care

- Consider automated methods of auscultation using digital devices linked to general practitioner databases.
- Promote auscultation in the presence of key indicators e.g. atrial fibrillation, heart failure, potential cardiac symptoms or a family history of bicuspid aortic valve.

Widen the availability of echocardiography

- This can be provided by or integrated with the local hospital.
- If not provided by the local hospital, the service must still fulfil British Society of Echocardiography or European Society of Cardiology Imaging Council standards. The full studies must be available for review at the local hospital.

  Examples include:

  - Community echocardiography services[10]
  - Moderate or severe aortic or mitral valve disease detected by open access echocardiograms referred directly to the heart valve clinic
  - Widened indications for echocardiography to include potential cardiac symptoms, chronic obstructive pulmonary disease with disproportionate breathlessness and raised B-type natriuretic peptide levels, atrial fibrillation[2,11]
  - Physiologist/scientist-led murmur clinics[12]
  - Triggers for echocardiography in computer-assisted nurse-led community clinics.

Improve recognition of valve disease

- All echocardiography services should have a system of alerts for significant HVD.
- Valve calcification on chest computerized tomography (CT) should be an indication for echocardiography.
- Raise awareness of HVD with teaching and training by cardiologists, general practitioners with a special interest, nurses or physiologist/scientist running the heart valve clinic.

  Examples include:

  - Study days for general practitioners, doctors in training, nurses and physiologist/scientists (target Primary Care Network Cardiovascular Disease leads)
  - Articles in liaison newsletters
  - Grand round presentations
  - Teaching within valve clinics
  - Web-based teaching methods
- Future developments could include computer assisted diagnostic prompts.
- Improve awareness of guidelines for HVD management amongst secondary care physicians.

Rapid valve assessment

Triage of outpatient referrals to a heart valve clinic to provide rapid assessment *within 48 hours* with:

- Suspicion of endocarditis (unless immediate hospital admission required).
- Symptoms and signs of heart failure with a murmur.

Or within *2 weeks* for those with clinically suspected symptomatic, severe HVD. Examples include:

- Evidence of severe HVD and new LV systolic dysfunction and/or significant pulmonary hypertension.
- Severe valve disease and new symptoms.

Approach to mild Disease

Mild disease is very common, occurring in about 50% of patients >65 years.[2] Most cases do not progress to severe.

- Advice should be available to general practitioners e.g. physiologist/scientist-led murmur clinic,[12] comment on report from a cardiologist, automated advice in the conclusion from a drop-down menu.
- A local strategy should be agreed that can include no follow up or repeat echocardiography in 3-5 years via open access or automated call back.
- Rapid review should be available if the clinical state changes.

Efficient communication

This must occur throughout the network linking community, district hospitals and the heart valve centre and will depend on local arrangements:

- Conventional communication after outpatient meetings, tests or inpatient visits must occur reliably to all involved with the patient's care.
- Electronic Health Records will greatly improve communication but are still in development. These may allow central tracking of patients followed up locally.
- Some networks may explore a patient passport.
- Case referrals and discussions can occur through regular teleconferences but more immediately using mobile phone-based digital communication systems.
- A general practitioner should be able to refer a patient directly to the valve service, particularly for a new symptom or if endocarditis is suspected.
- A contact within the multidisciplinary heart valve team (MDT) with dedicated contact details should be provided.
- There should be a defined route for patients to self-refer if known to the valve service if they experience a significant new symptom.

Component 2: Monitoring people with HVD

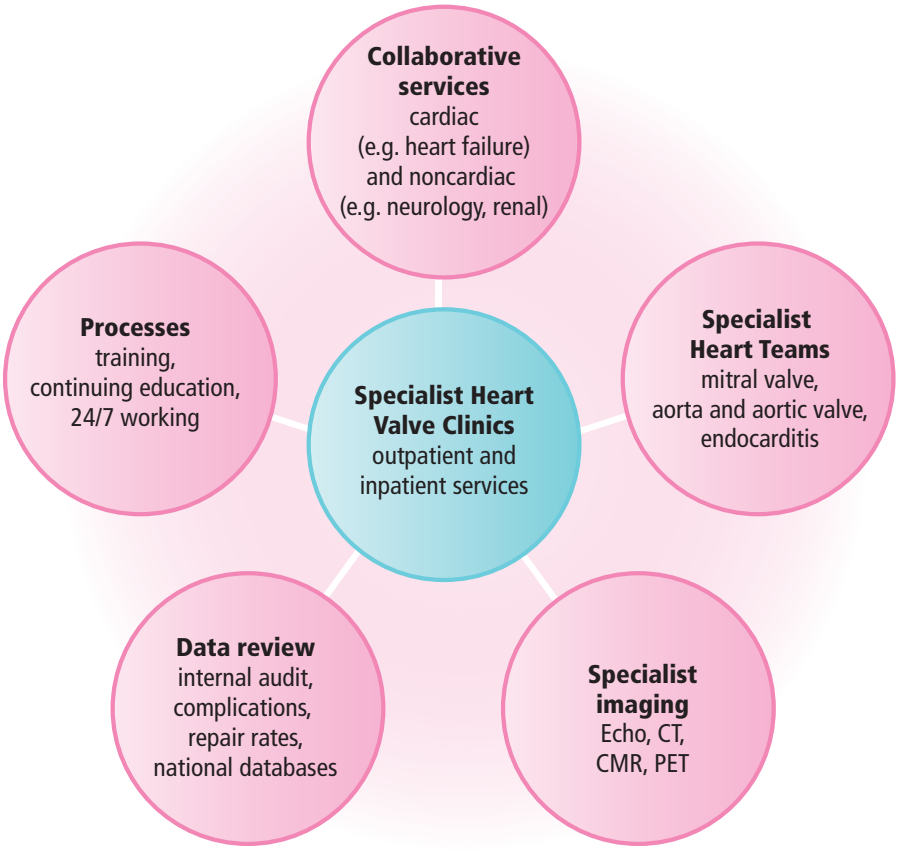
Aims:

1. To monitor all patients with moderate or severe HVD under the auspices of a clinic supervised by a cardiologist with specialist competencies in HVD, ideally in a heart valve clinic.
2. To determine the correct timing of intervention.
3. To determine mode of intervention and refer to the appropriate service at the heart valve centre.
4. To educate and inform patients.

Background:

- HVD is a progressive disease that is associated with morbidity and mortality if timely treatment is not delivered. It is vital to ensure rapid recognition of symptoms and adverse effects on heart function.
- Care is best delivered by healthcare professionals with appropriate competencies,[13] ideally in a heart valve clinic.[3,7]
- Heart valve clinics improve implementation of guidelines[14] at lower cost than general cardiology clinics[15] leading to earlier recognition of symptoms[16] and improved outcomes.

Figure 5. Key components of a specialist heart valve centre



Recommendations:

Heart valve clinic

- HVD can be managed in a general cardiology clinic provided that the healthcare professionals involved have specialist valve competencies *[Annex 1]*.[13]
- DGH-based heart valve clinic should have links to the specialist heart valve clinic and interventional services at a heart valve centre.
- There should be provision for rapid assessment of patients with symptomatic severe valve disease.
- There should be provision for rapid transfer of urgent cases to the heart valve centre, e.g. patients with severe unstable symptoms or severely impaired left ventricular function.

Community monitoring

- Surveillance can be devolved to the community after initial assessment provided this is led by a healthcare professional with specialty competencies e.g. a general practitioner with a specialist interest in cardiology or physiologist/scientist running a murmur clinic.
- There should be valve register and a process of quality assurance.
- There should be strong links with the valve clinic at the hospital including tracking from the valve clinic.
- There should be clear guidance on indications for referral back to the valve clinic.

Specialist heart valve clinic

- A specialist heart valve clinic can provide enhanced assessment for patients referred from a clinic in a DGH:
- It is run by specialists in HVD.
- It is embedded in a heart valve centre with direct access to all the components outlined in *[Figure 5]*.
- The specialist heart valve clinic must be integrated within all components of the heart valve centre *[Annex 3, Figure 5]*.
- Specialist clinics have organisational as well as medical aims *[Figure 6]* offering advantages over general clinics.
- The roles of all disciplines involved in the care of valve disease are provided in *Annex 2*.
- Patient education is a key role and includes symptoms of valve disease or endocarditis, indications for intervention and types of intervention available.
- Family planning and contraception advice should be offered and referral to an obstetrician as appropriate for pregnancy planning.
- Advice about life-style should be offered including smoking cessation and weight control.
- Patients suitable for a heart valve clinic should be determined by inclusion and exclusion criteria:

  Inclusion criteria:

  – At heart valve centres, specialist heart valve clinics must cover all aspects of valve care including follow-up of moderate and severe aortic or mitral native valve disease, aortic disease, and bicuspid aortic valve disease, and care after invasive intervention.

– It is not appropriate to have only a clinic dedicated to TAVI or transcatheter mitral procedures although separate clinics for these can coexist.

Exclusion criteria:

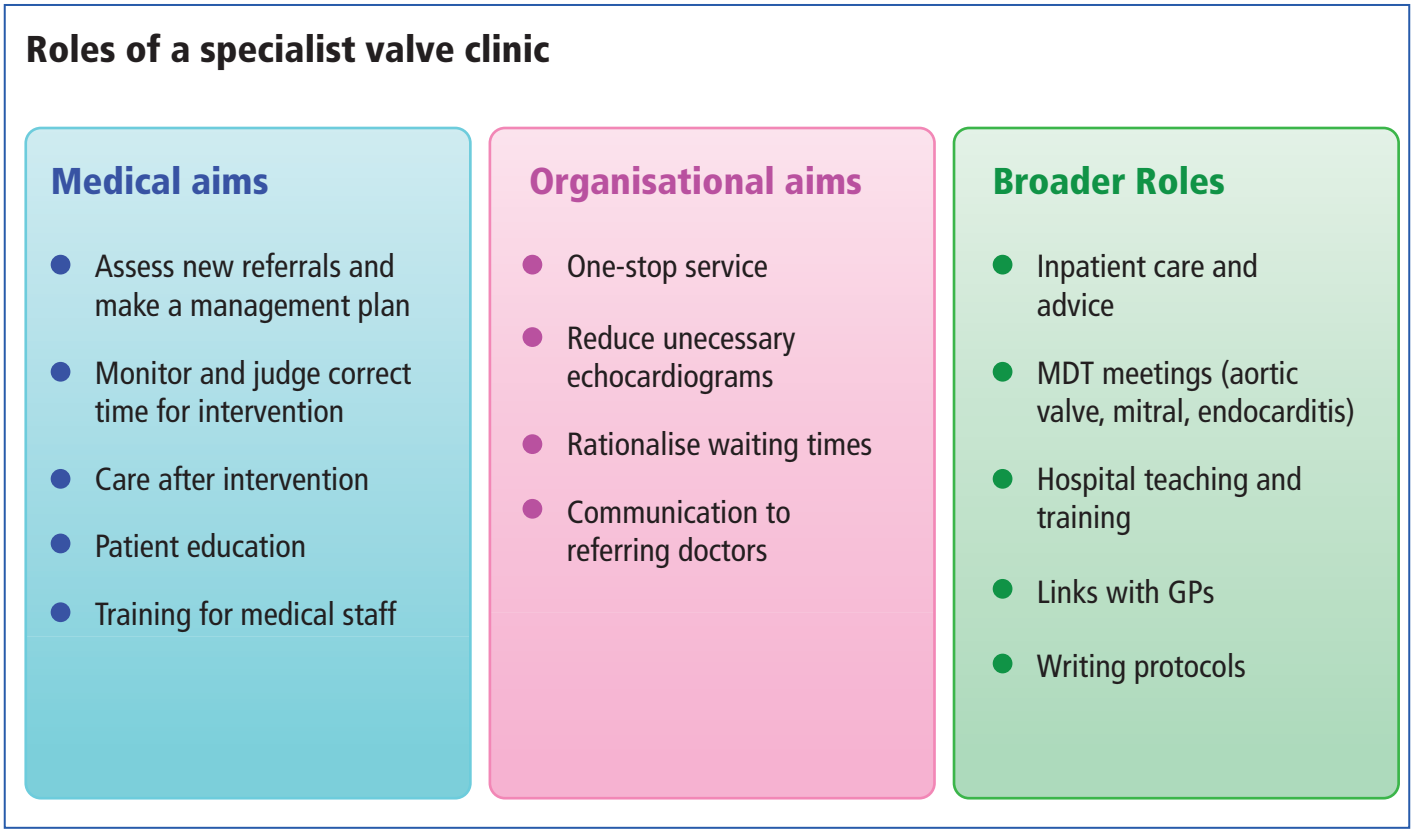
– Pathways should be agreed at the inception of the clinic to exclude patients with only mild disease or multiple comorbidities (who may be more suited to an elderly care clinic) and those with secondary mitral regurgitation (who may be more suited to a heart failure clinic). Moderate tricuspid regurgitation may not need regular follow-up if there is no associated left-sided valve or myocardial disease.

Diagnostic services

A full range of cardiac imaging modalities and other diagnostic services should be available:

- Echocardiography delivered as a one-stop service.
- Exercise testing using a treadmill or bicycle.
- Biomarkers (principally B-type natriuretic peptide).
- Stress echocardiography, CT and cardiac magnetic resonance (ideally at the same hospital but otherwise by referral to the local cardiac centre).

Figure 6. Roles of a specialist valve clinic



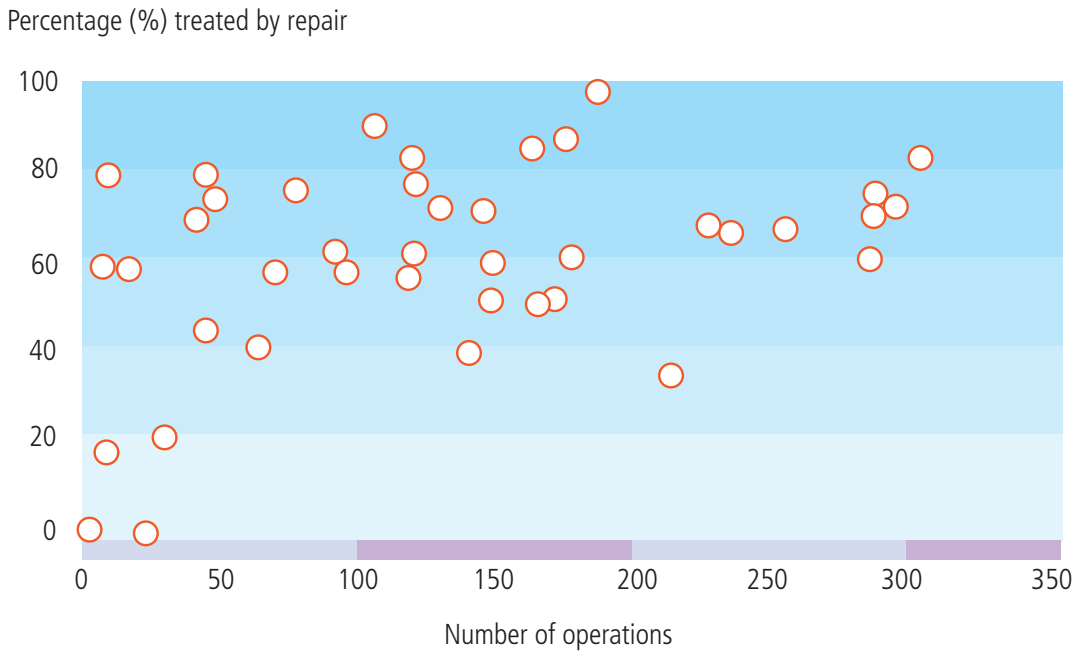
Component 3: Heart valve centres

Aims:

1. To ensure that efficient referral pathways to a heart valve centre exist for patients with symptomatic or severe HVD.[8,9]
2. To provide a collaborative, patient centred heart team decision-making process.
3. To ensure heart valve centres achieve optimal outcomes by adequate interventional volumes, facilities and processes.

Figure 7. Percentage of patients with mitral prolapse having repair at individual cardiothoracic surgical centres by annual volume

Data from 2008[5]



Background:

- Many patients with HVD are referred too late or not at all for valve intervention (surgical or transcatheter) resulting in increased morbidity and mortality.
- Expertise in valve treatments varies across the country resulting in variable outcomes.[5]
- Procedures that are performed at high volume centres are associated with lower risk and better outcomes.[8,9]
- Repair rates for mitral valve prolapse range from 0 to 100% (mean 67%) against the expected rate of >90%[5] *[Figure 7]*.
- Perioperative care for patients with HVD often requires a multidisciplinary approach. This is to optimise outcome after valve intervention and treat complications such as heart failure, haemodynamic instability or rhythm disturbances.

Recommendations:

Heart valve centre

- Assessment of patients with HVD considered for treatment should be undertaken by a multidisciplinary heart valve team (MDT) in a heart valve centre.
- The MDT is responsible for the overall inpatient and outpatient care of the patient and formal MDT meetings for making decisions are one part of this.
- The components of a heart valve centre[8,9] are summarised in Annex 3 and Figure 5.

Referral pathways to the heart valve centre [Figure 6]

- Pathways for patients with decompensated severe disease should operate all 24 hours and 7 days a week.
- Elective patients may be referred either for assessment or for specific therapy and should be triaged to the appropriate service.
- The purpose of triaging is to ensure:
  - Prioritisation of high risk cases (e.g. severe aortic stenosis with accelerated symptoms, haemodynamic decompensation, or new left ventricular dysfunction)
  - Patients are referred to the most appropriate clinic or services
  - If patients need further assessment they should be seen initially at the specialist heart valve clinic.
- Triaging processes will vary from hospital to hospital but should be run by clinical staff, for example a specialist valve nurse with advice from a cardiologist when required.
- *Figure 8* illustrates the core elements of the referral pathway for assessment and intervention at the heart valve centre.

Integrated advanced assessment

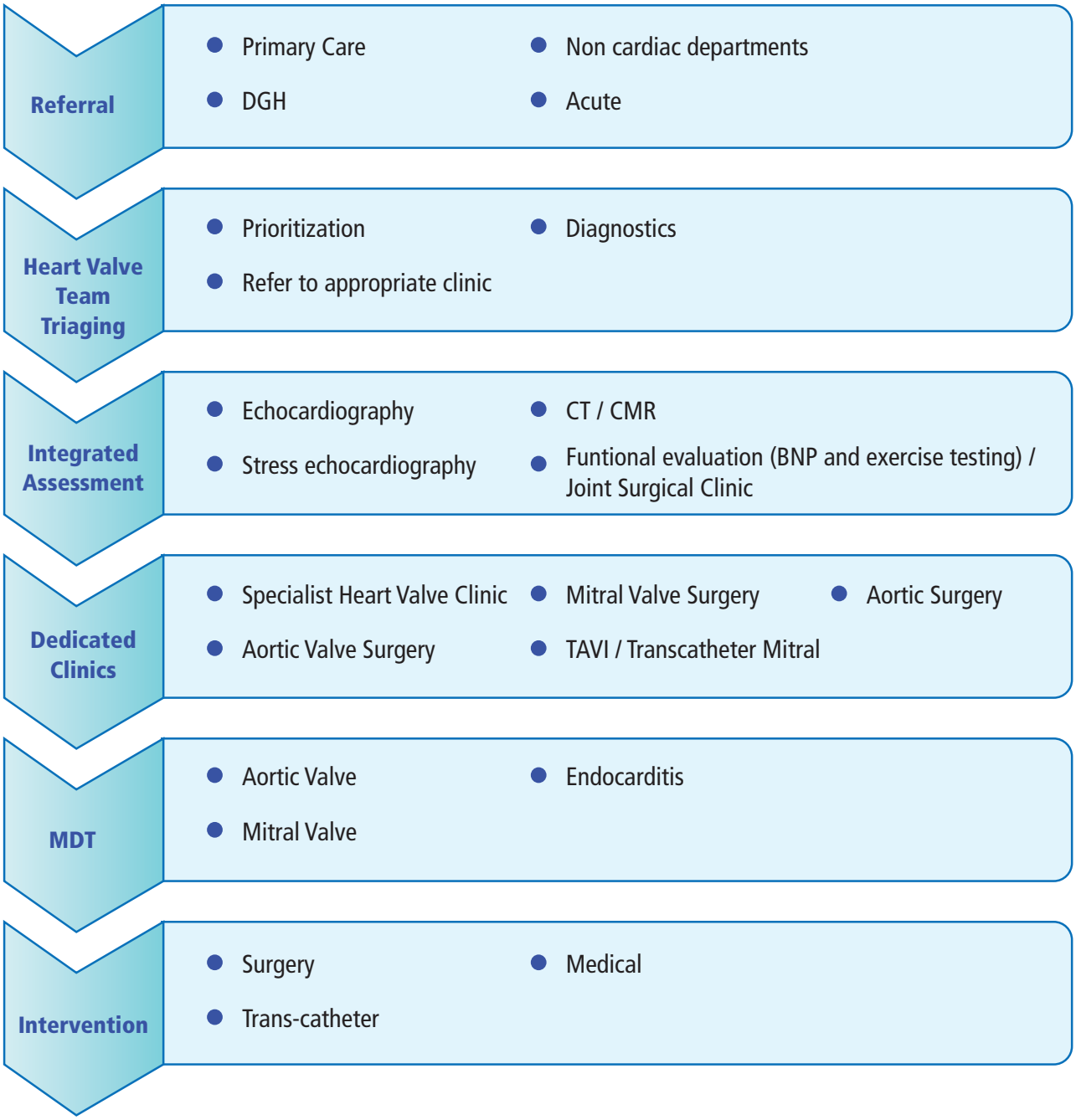
- Assessment for intervention should include clinical review, echocardiography and other imaging *[Annex 3]*, biomarkers, and functional evaluation (including exercise testing if necessary).
- Referring hospital and heart valve centres should share data through a collaborative network of HVD care.
- The heart valve team assessment should have a rigorous process in place for the assessment of patients with frailty and multimorbidity to avoid futile interventions.
- Elderly care expertise should be incorporated in the service to support decision-making and patient selection by the heart team.
- The HVD service should have links with heart failure and palliative care services if intervention is not feasible or is considered clinically inappropriate.

Patient engagement

- One of the main roles of a heart valve clinic is to educate patients to help inform their involvement in decision-making.

- Shared decision-making principles should be applied with clear explanation of the risks of the procedure. The patient's wishes are key. It is therefore vital that at least one member of the MDT has met the patient and can communicate their wishes. The outcome of the MDT should be communicated to the patient as soon as possible.
- The option of optimal medical therapy as an alternative to intervention should be discussed, especially in patients with complex care requirements where quality of life benefits may be more limited.

Figure 8. Referral pathway for patients with heart valve disease



Thresholds for intervention

- International guidelines for intervention should be followed. If guidelines are not followed, the reasons for this should be clearly stated.

Multidisciplinary heart team meetings

- All cases that are complex or deviate from guidelines should be discussed at an MDT meeting. Ideally all cases should be discussed in order to ensure standardised practice. If this is not feasible, centres should consider discussing a sample of all referrals.
- General standards of good practice for the MDT meeting process are shown in *Annexes 4-7*.
- Facilities for remote involvement with a DGH should be available.

Multidisciplinary perioperative care

- Perioperative care for patients with HVD should be by an MDT. This allows the optimization of outcomes and the treatment of complications like heart failure, haemodynamic instability or rhythm problems.

Communication between secondary care and tertiary (or quaternary) care heart valve centre

- Efficient and high quality communication should occur at every level in the network of HVD care (and not only between DGH and heart valve centre) to ensure all providers involved in patient care are aware of management decisions.
- All cases with infective endocarditis and severe decompensated valve disease should be referred within 12 hours of DGH admission to a DGH cardiologist. The case should then be discussed with the MDT at the heart valve centre to allow decisions concerning transfer.
- There should be a fast and reliable means of communication during office hours e.g. on-call phone, e-mail, computerised system, smart phone.
- Specialist valve out of hours advice should be available to on-call general cardiologists and surgeons.
- Patients should be informed of the results of MDT discussions and a plan for their further care discussed with them.

Intraoperative transoesophageal echocardiography (TOE)

- Valve surgery/interventions should receive intraoperative TOE support by operators with appropriate training and accreditation.
- TOE probes and machines should comply with the recommended quality framework.
- TOE operators should have expertise in assessment of valve disease and prosthetic valve function and repair.
- TOE studies should include minimum standard views before and after valve surgery and should be archived and reported.

A robust internal audit and governance process should be in place (including quality targets for aortic and mitral valve surgery)

- Suggested data requirements are shown in *Annex 8.*

- Suggested mitral valve quality target[s(8)] for mitral valve prolapse are shown in *Table 1*.
- All GIRFT (getting it right first time) recommendations should be implemented *[Annex 9].*

Table 1. Proposed targets for surgical outcomes in repair of mitral valve prolapse[17-20]

	Rate
Mortality (inpatient)	<1%
Major complication	<2%
Repair rate for P2 prolapse	≥95%
Repair rate for prolapse other than P2 judged repairable by MDT	≥90%
Significant residual (≥mod) mitral regurgitation	≤5% at 5 years
Reoperation rate	
Posterior leaflet repair	<1% per year
Anterior repair	<2% per year

Type of procedures and minimum volume of procedures

- Heart valve centres should provide replacement of valves in all 4 positions, mitral or tricuspid valve repair, aortic root and ascending aortic surgery, surgical atrial fibrillation ablation, transcatheter aortic valve implantation.
- The heart valve centre should ensure an adequate volume of procedures per centre and operator to maintain optimal outcomes *[Table 2].*
- Where appropriate, patients should be informed of techniques not available at their centre of care and should be offered referral elsewhere. Examples include the Ross procedure, aortic valve repair, and transcatheter mitral procedures.

Table 2. Suggested minimum annual centre and individual operator volumes[21-25]

Procedure	Heart valve centre	Individual operator
Mitral procedures (repair and replacement)	100	50
Percutaneous mitral edge-to-edge repair	25	NA
Aortic valve replacement	100	25
Aortic root replacement	40	NA
TAVI	75	40

These are based on expert consensus or retrospective analyses. Excellent results confirmed by external audit are more important than volume targets. However, excellent results are more likely with high volume operators in high volume centres.

NA - no consensus available

Component 4: Inpatient care of patients with HVD

Aim:

1. To ensure that all patients admitted with complications of HVD are assessed and managed by a healthcare professional with competencies in HVD.

Background:

- Patients are commonly admitted to hospital with complications of HVD (heart failure, arrhythmia, embolic complications, endocarditis) but do not always receive early specialist input from professionals with HVD expertise.
- Inpatient interventions are often required to prevent adverse outcomes.
- Currently communication between DGH and heart valve centre may be suboptimal.

Recommendations:

Access to specialist heart valve opinion

- There should be access to advice from a cardiologist with competencies in HVD every day of the week.
- Critically ill patients should have access to immediate advice.
- A cardiologist should see a patient with possible endocarditis or decompensated valve disease within 12 hours of admission.
- A specialist opinion should be available for non-critical cases within 24 hours.

Communication with the heart valve centre

- To enable prompt decisions for transfer, the DGH cardiologist should discuss all cases with infective endocarditis or severe decompensated HVD with the MDT at the heart valve centre.
- Specialist out of hours advice should be available to on-call cardiologists and surgeons.

Component 5: Care of patients after valve intervention

Aim:

1. To ensure that patients after valve intervention receive appropriate post-operative care, rehabilitation, and clinical monitoring.

Background:

Patients after valve intervention:

- May not always have access to rehabilitation which is an important aspect of recovery and optimisation of outcome.
- May require additional input from collaborative services (e.g. heart failure, electrophysiology).
- Require surveillance of their replaced or repaired valve due to the potential for structural valve deterioration.[26]
- Have a higher risk of infective endocarditis than patients with native valve disease.
- May need surveillance of other valve or structural lesions.
- Are prone to developing new arrhythmias requiring treatment.

Recommendations:

- Echocardiography should be performed according to a minimum standard protocol and at guideline recommended frequencies.
- Endocarditis prevention programmes should be developed *[see component 6]*.
- There must be a clear pathway for routine cardiac rehabilitation.
- There must be provision for surveillance in a heart valve clinic.
- There must be surveillance in an anticoagulation clinic with range or target international normalised ratios (INR) agreed between a cardiologist, surgeon, haematologist and pharmacist according to local arrangements.
- A hospital policy on bridging before non-cardiac surgery should be agreed.
- Patient education should be a key component of outpatient surveillance and should include awareness of symptoms of endocarditis or replacement valve failure.
- There must be clear and prompt communication with the patient's general practitioner to include details of longer term follow up, frequency of echo (arranged by secondary care) and expectations of primary care.

Component 6: Infective endocarditis

Aims:

1. To reduce the risk of patients with HVD developing infective endocarditis (IE).
2. To ensure that patients who develop IE are treated to a consistent high standard to reduce morbidity and mortality.

Background:

- IE is associated with high morbidity and an inpatient mortality of 20%.
- Late diagnosis of IE and delayed referral for surgery result in poor outcomes.
- Sub-optimal communication between DGH and heart valve centres leads to delayed referral and treatment with adverse impact on clinical outcomes.
- An MDT approach to management of IE is best practice[27,28] and reduces mortality.[29,30]
- Surgery is performed in at least 50% of cases and its timing requires careful discussion.

Recommendations:

Intervention

- Surgery must be performed as soon as indicated. Delay greatly increases the risk of complications.
- Sufficient capacity is required in operating lists and intensive therapy units in order to accommodate urgent surgery.
- Percutaneous extraction of implanted electrical devices should be available at the heart valve centre or a service-level agreement should exist to allow transfer to centres which provide this service.

Education and prevention

- Patients at risk of endocarditis should be informed of the symptoms of IE to facilitate early diagnosis.
- The need for regular dental care should be stressed.
- The need for antibiotic prophylaxis should be discussed and the results recorded and communicated to the dentist and general practitioner.
- Patients should have a point of contact in the valve service to report new symptoms.
- IE prophylaxis protocols should be available to non-HVD healthcare professionals.

Early identification and risk stratification

- Alert protocols should be in place between the echocardiography, microbiology and IE teams.
- Patients should be made aware of red flag symptoms.

Communication with heart valve centre about patients with IE

- All patients with IE should be discussed with the valve team at the heart valve centre within the first 12 hours of admission to allow decisions regarding transfer and management.
- There should be a fast and reliable means of communication during office hours e.g. on call phone, dedicated e-mail contact, digitised solutions for communication and image transfer.
- There should be regular communication between district hospital and the heart valve centre concerning all patients with IE.
- Patients with high-risk features should be transferred to the heart valve centre *[Box 1]*.
- A cardiologist or heart valve clinical nurse specialist with competency in IE should be identified as a point of contact in the heart valve centre.

Box 1. Indications for transfer to a surgical centre

Prosthetic valve or implantable cardiac electronic device infection
Severe regurgitation (even if haemodynamically stable)
Heart failure
Abscess
Invasive organism e.g. S aureus*
Organisms that are hard to manage medically e.g. fungi
Failure to respond to antibiotics
Stroke (or other embolism) and large residual vegetation
Recurrent emboli
Renal failure#

** Cases of S aureus IE may respond to antibiotic therapy alone, but should be discussed routinely.*

 # Renal failure in IE has multiple causes, including glomerulonephritis, renal emboli, aminoglycoside therapy and low cardiac output, and may contribute to the decision for early surgery when associated with severe valve destruction or failure to control sepsis. Discussion with the heart valve centre is essential.

Multidisciplinary management

- Care of patients with IE should be delivered by an MDT. The minimum requirement is a cardiologist and a microbiologist/infection specialist at a DGH with the addition of a surgeon at a heart valve centre.

- There should be regular MDT meetings *[Annex 7]* to follow the progress of inpatients and new referrals. The need for formal discussion should never delay emergency surgery and the operating schedules should allow urgent or emergency surgery in patients with IE.
- Other experts should also be available:
  - A specialist in spinal conditions (orthopaedic surgeon or rheumatologist depending on local practice)
  - An electrophysiologist specialised in extraction of implanted electrical devices
  - A neurologist and neurosurgeon to advise on the management of cerebral complications
  - A renal physician
  - Substance misuse specialist.

Access to investigation

- Transthoracic echocardiography should be performed within 1 hour if there is clinical evidence of heart failure or severe valve destruction.
- Transthoracic echocardiography should be performed within 24 hours if there is at least a moderate clinical suspicion of IE.
- Transthoracic echocardiography should not be used as a fever screen.
- Hospitals should develop an approach to the investigation of fever that places echocardiography appropriately with other investigations including blood cultures.
- There should be a low threshold for discussion with the members of the IE MDT to guide further investigations.
- Patients with high risk features should have access to TOE within 48 hours to guide management and planning of early surgery if appropriate.
- Positron emission tomography should be available (e.g. for patients with equivocal or negative echocardiography and mechanical valve replacements or implanted electrical devices) and is usually provided at the heart valve centre.

Summary of HVD service recommendations

Heart valve networks should include:

- **Seamless communication between community (annex 10), district hospital and heart valve centre**
- **Development of community registers, recall and review systems, and audit**
- **Improved detection of valve disease including wider provision of echocardiography**
- **Integrated pathways reflecting a disease-orientated approach**
- **Patient empowerment through education and provision of information**
- **A process for triaging patients found to have heart valve disease.**

- All disciplines caring for patients with heart valve disease should have relevant competencies.
- A cardiology opinion should be provided for all patients admitted with decompensated heart valve disease or with infective endocarditis. A district general cardiologist should discuss transfer of these cases with the multidisciplinary team at the heart valve centre.
- A heart valve clinic should be established in every secondary care hospital to provide key diagnostic services and establish guideline-informed protocols.
- Heart valve centres should have:
  - Appropriate infrastructure and resources to implement best practice guidelines
  - Specialist heart valve teams comprising multidisciplinary expertise deliver integrated care-pathways
  - Clear referral pathways into the centre and excellent communication with all clinicians involved with the patient's care
  - Multidisciplinary perioperative management
  - Systems which ensure collection of detailed outcome data for internal and external audit.

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Annex 1

Methods of demonstrating competencies in heart valve disease

Training and qualification

All disciplines including cardiologists:

- Training at a specialised heart valve centre.
- Attendance at valve-related training events formally designated by accreditation points from representative national or international body e.g. British Heart Valve Society, European Society of Cardiology, American Heart Association.
- Other methods of demonstrating specialist training e.g. participation in case-discussions on recognised platforms, web-based modules e.g. BJC/BHVS programme.
- A valve disease syllabus is available on **www.bhvs.org.uk** (link). An ESC Council on Valvular Heart Disease (EACVI) syllabus based on this is being developed.

Surgeons and interventionists:

- Basic training in valve disease is part of general board certification.
- Adequate procedural numbers and outcomes according to standards available in opinion papers and defined by national specialist societies.

Physiologists/scientists:

- The role must be undertaken following the principles of Good Scientific Practice ensuring individual accountability and overall patient safety.
- Ideally registration as clinical scientist with HCPC or working towards STP equivalence.
- Participation in local or national clinical skills courses (ideally an MSc or PhD in cardiology) in a related area e.g. advanced echocardiography for valve disease, prescribing, diagnosis, clinical skills, requesting appropriate investigations, interpretation of results, acting on these, patient education and support, onward referral to palliative care, heart failure team / clinics.
- Knowledge of adjunct investigations such as exercise tolerance testing in heart valve disease, biomarkers for heart failure, CT scanning for aortopathies and TAVI work-ups etc.

Nurses

- There is already significant specialisation within Cardiology Nursing.
- Specialist valve disease training should be delivered locally under supervision of the cardiologist leading the valve service.
- This can be supplemented by relevant university-based modules.

Annex 1

Methods of demonstrating competencies in heart valve disease

Specialised practice	• Examples of essential practice depend on discipline but include supervision of a valve clinic, performing specialist valve imaging studies, performing mitral valve repairs, being part of the endocarditis team, seeing inpatient referrals with valve disease, and writing departmental protocols. • Ideal criteria include involvement in teaching and in local or multi-centre research. • Audit of results is a necessary part of maintaining a high quality service.
Continuing Professional Development	• Meetings with valve-specific scientific or educational components, many organized by national or international societies. • Membership of a specialist society is encouraged, e.g. BHVS or ESC Council on Valvular Heart Disease.

Abbreviations

BHVS	British Heart Valve Society
BJC	British Journal of Cardiology
CT	Computerised tomography
ESC	European Society of Cardiology
HCPC	Health and Care Professions Council
STP	Scientist Training Programme
TAVI	Trans catheter aortic valve implantation

Annex 2

Specialist heart valve clinics - multidisciplinary members and their roles

Lead of valve clinic	• Local arrangements will vary depending on the nature of the clinic. Most patients will be initially managed conservatively and a cardiologist is the most appropriate lead. • Surveillance can be devolved to physiologists/scientists or nurses with improvement in quality and reduction in cost compared to general clinics.
Role of cardiologist or GP with Special Interest	• Assessment of new referrals including management plan. • Deciding need for endocarditis antibiotic prophylaxis. • Follow-up of complex valve cases. • Determining risk of non-cardiac surgery. • Advising on anticoagulation perioperatively. • Support for nurse and physiologist/scientist clinics. • Referral for intervention or for other specialised opinion. • Communicating to referrer, GP and patient.
Role of nurse	• Clinical history, medication review and examination. • Lifestyle advice. • Discuss with cardiologist as needed. • Communicating to referrer, GP and patient.
Role of physiologist / scientist	• Clinical history, medication review and examination. • Life-style advice. • Echocardiography. • Discuss with cardiologist as needed. • Communication with GP, referrer and patient.

Abbreviations

GP General practitioner

Annex 3

Components of a Heart Valve Centre

SPECIALIST VALVE CLINIC Minimum	Additional at selected centres
Imaging	
Departments and individual imagers accredited by recognised national or international systems (e.g. BSE or ESC council of cardiovascular imaging) offering: • 24/7 echocardiography. • Transthoracic echocardiography (including 3D). • Stress echocardiography. • Transoesophageal echocardiography. • Intraoperative TOE. • Cardiac CT. • CT-PET. • Cardiac magnetic resonance.	
Procedures available	
Surgical: Replacement of all valves, mitral valve repair, tricuspid valve repair, surgery for aortic root and ascending aorta, atrial fibrillation ablation. **Percutaneous:** TAVI, links with hospitals offering super-specialist techniques.	**Surgical:** Ross procedure, aortic valve repair, robotic mitral valve repair, heart transplant. **Percutaneous:** Balloon mitral valvotomy, closure of paraprosthetic regurgitation, emerging mitral and tricuspid valve interventions, mitral repair procedures, (e.g. MitraClip).
Collaborative services	
Other specialist cardiac services (including heart failure and electrophysiology), intensive care (dedicated beds, extra-corporeal membrane oxygenation). **Extracardiac specialties:** vascular surgery, general surgery, neurology, renal, stroke, elderly care medicine, psychology, genetics, and dental surgery.	Percutaneous extraction of pacing devices.

Annex 3

Components of a Heart Valve Centre

SPECIALIST VALVE CLINIC Minimum	Additional at selected centres
Processes	
Organisation into multidisciplinary teams (including endocarditis). 24 hour, 7 day cover allowing for annual leave and sickness. Culture of safety (e.g. World Health Organisation checklist, review of complications). Training. Job-planning to include valve-related sessions (including continuing education).	Research programmes.
Data review	
Internal audit processes (including rates of repair and haemodynamic results, complications, durability of repair and rates of reoperation - assessed annually and ideally summarised at 5 and 10 years). Involvement in national databases with mandatory external review.	
Training	
Training is an essential role and should be established, coordinated and monitored by national cardiovascular professional societies.	

Abbreviations

BSE	British Society of Echocardiography
CT	computerised tomography
ESC	European Society of Cardiology
PET	positron emission tomography
TOE	transoesophageal echocardiography
TAVI	transcatheter aortic valve implantation

Annex 4

Good practice recommendations for MDT meetings

- A multidisciplinary approach is recommended for the management of all patients with heart valve disease, including infective endocarditis.
- Individuals with areas of expertise (e.g. echo interpretation, TAVI, aortic valve repair, mitral repair) should be named. Depending on local arrangements, nurses and case-managers may also be involved in the multidisciplinary team.
- Assessment by relevant non-cardiac specialists (e.g. elderly care physicians, respiratory physicians, etc.) should be available for patients with significant comorbidities.
- Meetings should occur with regular scheduling, usually weekly, or more or less often depending on hospital case volumes.
- Meetings should include discussion of patients in whom there is a clear indication for surgery in order to maintain transparency and peer-reviewed decision making.
- Ad hoc multidisciplinary consultations should be possible in order to facilitate emergency intervention; vital treatment should never be delayed pending the next formal MDT.
- Clear referral pathways to the MDT should exist.
- MDT meeting outcomes should be clearly documented and collated in a database.
- IT solutions should be available for referral to the MDT and communications regarding meeting outcomes.
- An MDT coordinator is required to coordinate MDT referrals and gather all information required.
- The patient is central and his or her views will inform the discussion of treatment options at multidisciplinary meetings. The consensus of the meeting will be communicated to the patient and informs further discussion about the timing and nature of surgery. It may be appropriate to invite a patient to a discussion about his or her case.
- Communication with referring DGHs should be optimized by considering involving referring Cardiologists by remote MDT, either via video or phone link.
- The results of the MDT discussion should be communicated with the patient and their general practitioner.

Abbreviations

DGH	district general hospital
IT	information technology
MDT	multidisciplinary team
TAVI	transcatheter aortic valve implantation

Annex 5

Good practice recommendations for mitral valve MDT meetings

Objective	Frequency	Documentation	Participants
• Review clinical data and imaging of all patients considered for mitral valve surgery. • Determine indication for intervention. • Determine appropriateness of intervention and frailty (especially in multi-morbid or elderly patients). • Determine risk of intervention. • Determine likelihood of repair in primary MVD. • Assign repairable primary MVD to a mitral repair surgeon with volumes and results meeting quality targets *(see Table 1 and 2)*. • Consider trans-catheter interventions. • Clinico-pathological feedback. • Discussion of all adverse events in order to share learning and minimise risk of recurrence.	At least weekly, or more frequently depending on hospital case volumes.	Documentation should include: - date of MDT. - participants. - outcome. - communication with patient, GP, referrer. MDT outcome database maintained to audit against actual intervention.	• **Key member** Mitral valve surgeon. • **Key member** Cardiologist with expertise in HVD ± imaging. • **Key member** Physiologist/scientist with expertise in imaging. • **Key member** Valve nurse. • **Key member** MDT administrator. • **Key member** Structural interventionist. • **Desirable member** Heart failure specialist (especially for patients with secondary mitral regurgitation or decompensated HVD). • **Other members can include:** Electrophysiologist, Microbiologist, Care of the Elderly physician, Respiratory physician, etc., depending on the case.

Abbreviations

GP	general practitioner
HVD	heart valve disease
MDT	multidisciplinary team
MVD	mitral valve disease

Annex 6

Good practice recommendations for aortic valve MDT meetings

Objective	Frequency	Documentation	Participants
• Review of imaging and clinical data of all patients considered for aortic valve surgery. • Determine indication for intervention. • Determine appropriateness of intervention and frailty (especially in multimorbid or elderly patients). • Determine risk of intervention. • Determine most appropriate intervention (TAVI v SAVR). • Discuss choice of valve to inform discussions with patient. • Consider need for intervention for concurrent valve disease (e.g. TV repair, MVD) or aortic disease. • Assign appropriate surgeon with special expertise • Consider referral to a super-specialist centre (e.g. very high risk surgery needing haemodynamic support or patients requesting minimal access surgery). • Clinico-pathological feedback. • Discussion of all adverse events including possible methods of avoiding them.	Weekly, or at a frequency appropriate for hospital activity.	Documentation should include: - date of MDT. - participants. - recommendation of MDT. - MDT outcome disseminated to referrer, GP, and patient. - MDT outcome database maintained to audit against actual intervention.	• **Key member** Cardiac surgeon. • **Key member** Cardiologist with expertise in HVD ± imaging. • **Key member** Physiologist/scientist with expertise in imaging. • **Key member** Structural interventionist. • **Key member** Valve nurse. • **Key member** MDT administrator. • **Desirable member** Heart failure specialist especially in patients with decompensated HVD).

Abbreviations

AVD	aortic valve disease	MVD,	mitral valve disease
GP	general practitioner	SAVR	surgical aortic valve replacement
HVD	heart valve disease	TAVI	transcatheter aortic valve implantation
MDT	multidisciplinary team	TV	tricuspid valve

Annex 7

Good practice recommendations for endocarditis MDT meetings

Objective	Frequency	Documentation	Participants
• Review of imaging and clinical data of all patients. • Determine indications for intervention. • Determine appropriateness of intervention and frailty (especially in multi-morbid or elderly patients). • Determine risk and timing of intervention. • Determine most appropriate intervention. • Assign appropriate surgeon with special expertise in case of concurrent aortic surgery in aortic root abscess. • Regular progress assessment. • Clinico-pathological feedback. • Discussion of all adverse events including possible methods of avoiding them.	Weekly, or at a frequency appropriate for hospital activity.	• MDT outcomes should be recorded. • Document-ation should include: - date of MDT. - participants. • MDT outcome disseminated to referrer, GP, and patient. • MDT outcome database maintained to audit against actual intervention. • DGH should be kept updated.	• **Key member** Cardiac surgeon. • **Key member** Cardiac surgeon (expertise in complex valve surgery). • **Key member** Cardiologist with expertise in valve disease ± imaging. • **Key member** Physiologist/scientist with expertise in imaging. • **Key member** MDT administrator. • **Key member** Microbiologist. • **ACHD** (for congenital cases).

Abbreviations

ACHD	adult congenital heart disease	HVD	heart valve disease
DGH	district general hospital	MDT	multidisciplinary team
GP	general practitioner	MVD	mitral valve disease

Annex 8

Recommended data to be collected

Pre-operative
Demographic data, comorbidities.
Grading of valve lesion(s).
Pre-operative risk assessment and stratification using validated multivariate scores.
Early clinical results
Operative mortality and morbidity at 30 days, including stroke, mediastinitis, myocardial infarction, acute kidney injury.
Mitral valve repair rates based on pre-operative multidisciplinary team classification for repair as 'likely', 'unlikely' or 'not feasible.'
Length of stay on intensive care unit.
Baseline haemodynamic function
Transvalve velocity and mean gradient (all positions) and effective orifice area (aortic position) of replaced valves.
Presence and grade of paraprosthetic regurgitation.
Residual regurgitation, new obstruction or systolic anterior motion of the anterior mitral leaflet after surgical or transcatheter repair.
LV function, RV function and PA systolic pressure.
Follow-up
Complications: infection, valve thrombosis.
Mortality: at 1 and ideally 5 years.
Durability of repairs based on routine annual echocardiography (more frequent if significant regurgitation present). Proportion per year developing moderate or severe regurgitation.
Incidence and timing of structural and non-structural valve degeneration
Rates of re-do procedures per year.
Data dissemination
It is recommended that these results are presented on the heart valve centre website and made available to patients and referring clinicians.

Annex 9

GIRFT recommendations relevant to valve disease

Patient pathways and bed management

1 Make day of surgery admission routine practice.
2 Ring-fence beds on ward and ITU for elective cardiothoracic surgery.
3 Establish regional work-up protocols for non-elective referrals.
4 Pool non-elective cases ready for next available theatre session and next available appropriate surgeon.
5 Ensure that every patient is reviewed by a consultant pre- and post-operatively – and that this happens seven days a week.

The role of risk management in clinical outcomes

6 Establish a formal Standard Operating Procedure on cardiothoracic data validation, risk adjustment, outlier identification, escalation plans and reporting for GIRFT metrics.
7a Use uniform draping technique in theatre.
7b Use chlorhexidine skin preparation.
7c Ensure that individual cases of deep sternal wound infection (DSWI) are reviewed. by a multidisciplinary team (led by a consultant microbiologist).
8a Establish a national formal policy for complex and very high-risk cases.
8b Establish collective responsibility for clinical outcomes.
9 Attribute outcomes for complex and very high-risk cases to units rather than to individuals..
10 Record blood product transfusion rates for cardiac surgery

Mitral valve surgery

11 Ensure that patients with degenerative mitral valve disease are only operated on by specialist mitral valve surgeons.

Coding

12 Review the list of complications and comorbidities for cardiothoracic surgery, so that only codes that are genuinely relevant to the cost of treatment trigger a cc score in pricing, and that the HRG splits reflect an authentic variation in cost.
13 Increase collaboration between clinical cardiothoracic teams and coders by including coders in multidisciplinary team meetings and morbidity and mortality meetings.

NICOR data quality

14 NICOR should work with providers to improve the quality of data submitted and stored, specifically for return to theatre, deep sternal wound infection, new CVA, post-operative renal replacement therapy.

Annex 10

Summary of recommendations for community care of patients with heart valve disease (HVD)

Competencies in HVD

- All disciplines involved in care need specialist competencies demonstrated by specialist training, clinical activity, continuing professional development and membership of a specialist society.

Guidance to general practitioners

- A system of guidance should be agreed nationally to include: clinical presentation; indications for echocardiography; how to code echocardiography reports; principles of management; frequency of monitoring; criteria for referral to a hospital heart valve clinic.

Promote auscultation in primary care

- Key indicators are atrial fibrillation, heart failure, potential cardiac symptoms or a family history of bicuspid aortic valve.

Widen the availability of echocardiography

- Examples include open access echocardiography, or murmur clinics.
- Indications for echocardiography include murmur, atrial fibrillation, Chronic Obstructive Pulmonary Disease with disproportionate breathlessness and raised B-type natriuretic peptide level, family history of bicuspid aortic valve.

Community monitoring

- Surveillance can be devolved to the community after initial assessment provided this is led by a healthcare professional with specialist competencies e.g. a general practitioner with a specialist interest in cardiology or physiologist/scientist running a murmur clinic.
- There should be valve register and a process of quality assurance.
- There should be clear guidance on indications for referral back to the valve clinic.

Communication within the valve network

- There must be close two-way links with the local hospital based valve clinic sharing information about management decisions, Multi-Disciplinary Team discussions, discussion with patients, interventions, the results of tests, and changes in medication.
- Decisions about antibiotic prophylaxis before invasive dental procedures should be communicated e.g. using an information card carried by the patient.
- General practitioners should be able to refer immediately to the valve clinic if symptoms develop or change or if there is the suspicion of endocarditis.
- General practitioners should be able to request blood cultures e.g. within a hospital valve clinic or walk-in centre.