



المجلس الصحي السعودي  
Saudi Health Council

المركز الوطني للقلب  
National Heart Center

# Valvular heart disease in Saudi Arabia

Working together to create a better patient journey toward longevity  
and healthy aging in the Saudi population.

Policy brief June 2024

# Contributors

Several authors have contributed their knowledge and expertise to developing this policy brief.

## Dr Adel Tash

Director General of the National Heart Center, Saudi Health Council Advisor to the Assistant Minister of Health for Planning and Development

## Dr Abdulaziz Alrabiah

Director General of the General Directorate of National Health Policy and Economics, Saudi Health Council

## Dr Abdulrahman AlMoghairi

Interventional Cardiologist, Prince Sultan Cardiac Center, Riyadh, Director of Interventional Cardiology and Head of Catheter Laboratory, Director of the Research Department and Director of the Cardiology Fellowship Training Program

## Dr Abdulrahman Al-Qahtani

Interventional and Structural Cardiologist, Head of the Interventional Cardiology and Catheterization Laboratory, King Fahad Medical City, and Leader of the R2 cluster ACS service line

## Dr Fawaz Al Mutairi

Consultant Interventional Cardiologist, National Guard Hospital, and President of the Gulf Interventional Society

## Dr Feras Khaliel, MD, PhD

Consultant Cardiac Surgeon, Head of the Section of Adult Cardiac Surgery, Director of the Robotics and MIS Cardiac Surgery, Director of the Heart Transplant and MCS Program, and Professor of Medicine, Alfaisal University, King Faisal Specialist Hospital and Research Center

## Dr Hazim Rahbi

Head of the Structural Heart Unit and Consultant Structural and Interventional Cardiologist, Heart Health Centre, King Saud Medical City

## Dr Hussain Al-Omar

Associate Professor of Pharmacoeconomics and Director of the Health Technology Assessment Unit, King Saud University

## Dr Hussein Al Amri

Senior Interventional and Structural Heart Disease Consultant, Prince Sultan Cardiac Centre

## Dr Khalid Al Shibi

Interventional Cardiologist and Director of the Cardiac Center at King Fahd Armed Forces Hospital

## Dr Mirvat Al-Asnag, MD, FACC, FSCAI, FSCCT

Director of the Catheterization Laboratory, King Fahad Armed Forces Hospital, General Secretary of the Saudi Arabian Cardiac Interventional Society (SACIS)

## Dr Mohammed Al Otaibi

Senior Interventional Cardiologist, Prince Sultan Cardiac Center, and Head of Saudi Percutaneous Coronary Intervention Fellowship Program

## Dr Sondos Samargandy

Interventional and Structural Cardiologist, Prince Sultan Cardiac Center, Riyadh

## Dr Turki B. Albacker, MBBS, M.Sc, FRCSC, FACS, FACC, MBA

Professor of Cardiac Sciences, Cardiac Sciences Department, College of Medicine and Consultant Cardiac and Aortic Surgeon, King Fahad Cardiac Center, King Saud University Medical City

## Dr Waleed Alharbi, MBBS, FRCPC, FACC

Director of the King Fahad Cardiac Center, Department of Cardiac Sciences, College of Medicine, King Saud University Medical City, Riyadh

## Dr Wail Al Kashkari

Cardiology Consultant, Interventional ACHD, President of SACIS, SHA, and KAMC, Jeddah

**Disclaimer:** This document is a collaborative process facilitated and endorsed by the Saudi Health Council/National Heart Center/General Directorate of the National Health Policy and Economics. The findings, interpretations, and conclusions expressed herein do not necessarily represent the views of the Saudi Health Council.

Edwards Lifesciences supported the development of this policy brief.

## Cover image

© Getty image

# Contents

Contributors.....	2
Foreword .....	4
Executive summary.....	5
The patient care journey and a call to action .....	6
The hidden health crises impacting Saudi Arabia’s older population.....	9
What is valvular heart disease?.....	10
Why are people with valvular heart disease in Saudi Arabia not getting treated? .....	12
Opportunities for improving patient care for aortic stenosis in primary care.....	14
Barriers to care and missed opportunities for intervention .....	16
Policy recommendations.....	19
Conclusion .....	20
Glossary .....	21
References.....	22

This policy brief focuses on the impact of valvular heart disease (VHD), particularly aortic stenosis, on older individuals in Saudi Arabia. It aims to raise awareness, address gaps, and provide practical solutions for policy-makers, decision-makers, and health care professionals to improve the detection, diagnosis, treatment, and management of VHD.

Medical societies, non-governmental organizations, and the media play a crucial role in raising awareness and dispelling misconceptions about aging that may prevent individuals from seeking advice or accepting treatment.

# Foreword

Valvular heart disease (VHD) is a significant public health issue, particularly among older people. Despite being treatable and reversible, it often remains undetected and, therefore, undertreated. Failure to detect VHD early and initiate timely treatment can lead to acute health consequences for affected individuals and have longer-term repercussions for them, their families, and society.

Aortic stenosis is the most prevalent type of VHD in older individuals. It can lead to disability and death from serious complications resulting from a leaky heart valve or heart valve regurgitation, such as heart failure, stroke, or blood clots. Survival rates for individuals with aortic stenosis who are untreated, specifically those with heart failure, is around two years after symptom onset. Aortic stenosis takes a heavy toll on the health and wellbeing of affected individuals and their families. It also increases health care expenditures, as treatment for acute VHD often involves hospitalization, post-operative care, and rehabilitation. These medical costs borne by the health system and individuals can be avoided with early detection and treatment of VHD.

As many nations have prospered, life expectancy has increased, and so has the prevalence of diseases associated with old age. Saudi Arabia, despite having a young population, is expected to see a significant increase in the proportion of aged individuals in the future. Taking proactive measures will promote healthy aging, save lives, and reduce health care costs. Saudi Arabia's Vision 2030 strives to establish a comprehensive and efficient health system that prioritizes the well-being of individuals and the community. One of its objectives is to raise the country's average life expectancy from 74 to 80 years by 2030. With the current population above 60 years projected to increase from 1.2 million to over 5 million by 2030, early detection and treatment of diseases such as VHD are crucial for promoting healthy aging in the elderly by preventing complications, improving quality of life, saving lives, and effectively utilizing health care resources.

Furthermore, the policy actions needed to improve awareness, diagnosis, and management of VHD align directly with Saudi Vision 2030's goal of enhancing health care services and promoting a healthier population, contributing to a more productive and prosperous society.



**Our goal is to provide comprehensive cardiac evaluations to individuals aged 60 and above, prioritizing those with symptoms.** Additionally, we recognize the importance of detecting pre-symptomatic patients. Implementing regular check-ups is crucial, as cardiac diseases often reach an advanced stage by the time symptoms appear. It is essential to establish the necessary infrastructure, equipment, and staff at primary health care centers to inform policy decision-making.

## Dr Adel Tash

Director General of the National Heart Center, Saudi Health Council  
Advisor to the Assistant Minister of Health for Planning and Development

# Executive summary

Ongoing reforms are being implemented to transform the health care system in Saudi Arabia. These reforms aim to establish better patient tracking and follow-up mechanisms that will benefit the health system as a whole and help address common systemic barriers. Discussions around the reform process are also a golden opportunity to highlight the needs of older people and the potential future health threats they will encounter. Now is the time to pre-empt unnecessary illness due to VHD and put plans into place to strengthen detection, diagnosis, and provision of care.

This policy brief describes the burden of VHD, particularly aortic stenosis, on Saudi's older population. Age is a powerful risk factor for aortic stenosis.<sup>1</sup> Other risk factors are similar to those associated with cardiovascular diseases, including smoking, hypertension, elevated cholesterol levels, obesity, and metabolic syndrome.<sup>1</sup>

The brief also highlights the significant gap identified between the estimated number of individuals likely to be affected by aortic stenosis and those treated annually, which prompts the question: why are people with degenerative VHD in Saudi Arabia not receiving available treatment?

In this policy brief, three explicit opportunities for intervention are identified to address some of the common barriers to individuals obtaining optimal care. For each key area, there are recommendations to guide policy-makers and practitioners.



**Dr Abdulaziz Alrabiah**

Director General of the General Directorate of National Health Policy and Economics, Saudi Health Council

---

## The three key areas for policy intervention



**Raise awareness of VHD among the public and HCPs**



**Ensure timely diagnosis and clear referral pathways**



**Improve disease management**

# The patient care journey and a call to action

Policy-makers health systems, health care professionals, and research communities must take action to address the growing prevalence of valvular heart disease in the aging population and bridge the gaps in the patient journey.

## AWARENESS

Patients need to be able to recognize the symptoms associated with VHD and promptly communicate any concerns to their primary care physician (PCP). Equally importantly, health care professionals (HCPs) should be able to identify these symptoms and take the appropriate action.

### Actions for policy-makers

- Policy-makers should work closely and align their efforts to raise awareness among the public and HCPs about VHD in people older than 60.
- The population should be informed about the symptoms of VHD and encouraged to have regular check-ups.

### Actions for health systems and HCPs

- All HCPs, especially physicians working in primary health care, should be aware of VHD and the increased risk as people age.
- HCP associations or medical societies should provide training regarding promptly diagnosing and effectively treating VHD.

### Priority areas for research

- Gather evidence on the prevalence of VHD in Saudi Arabia.
- Fund and conduct more local research to help improve the health care community's knowledge and prioritization of VHD.

## DETECTION IN PRIMARY CARE

PCPs should proactively perform an auscultation to detect a heart murmur.

### Actions for policy-makers

- PCPs, HCPs in primary care, and physicians caring for hospitalized patients should receive training on detecting, diagnosing, treating, and managing VHD in an aged population.
- Policy-makers and payers should implement dedicated screening protocols or programs as part of healthy aging initiatives to ensure early detection and enable timely treatment.
- Patients with VHD should be made aware of available treatment options and incentivized to access appropriate care.

### Actions for health systems and HCPs

- PCPs must be trained to effectively examine and detect VHD, specifically aortic stenosis. Medical training, including residency and fellowship training programs, and continued medical education must capacitate PCPs to screen patients, including by auscultation, and actively refer them for follow-up treatment.
- Guidelines and practice should encourage routine screening for VHD in primary care for persons older than 60 using simple auscultation methods.

## DIAGNOSIS VIA ECHOCARDIOGRAM AND REFERRAL PATHWAYS

A patient with a heart murmur is referred for an echocardiogram to confirm the diagnosis. Upon diagnosis, the PCP should know which referral pathway to follow to ensure that a cardiologist sees the patient and the patient receives treatment.

### Actions for policy-makers

- Ensure that a workforce plan is in place that allocates the right skills and resources required at each level of the health system.

### Actions for health systems and HCPs

- Guidelines and practice should include referral of patients to secondary care or tertiary care for an echocardiogram.
- PCPs and cardiologists should receive skills development training in interpreting echocardiograms.
- Technicians, echocardiographers, and physicians should be provided with education modules on screening and evaluating patients with VHD.
- When a person is diagnosed with VHD, referral pathways must be clear for HCPs and patients. Health services for VHD patients must be integrated across various levels of health care and coordinated.

### Priority areas for research

- Gather data on the epidemiology of VHD in Saudi Arabia, including the demographics of individuals affected by aortic stenosis.

## TREATMENT AND LONG-TERM FOLLOW-UP

The patient and the multidisciplinary care team discuss treatment decisions, taking into consideration clinical guidelines and patient preferences. The patient undergoes valve repair or replacement through either surgical or transcatheter methods. The multidisciplinary team conducts regular follow-ups to ensure the patient's recovery and return to normal functioning.

### Actions for policy-makers

- Ensure availability of well-trained interventional cardiologists and cardiac surgeons for treating VHD patients referred from primary care.
- Insurance companies should include comprehensive VHD care coverage in their essential benefit packages, covering detection, treatment, and ongoing management.

### Actions for health systems and HCPs

- Train interventional cardiologists in transcatheter techniques and innovative treatments for VHD in elderly patients.
- Teach technicians in peripheral centers proper echocardiogram techniques.
- HCPs must educate patients about VHD consequences and treatment options, facilitating shared decision-making.
- Allocate adequate funding for VHD detection and management, taking into consideration the expected increase in prevalence due to aging populations.

### Priority areas for research

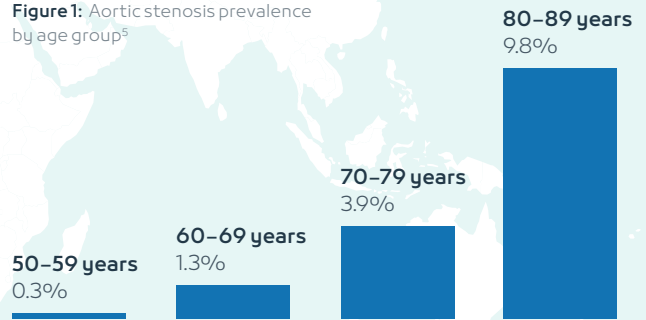
- Gather data on the outcomes of interventional strategies for VHD.

## Globally

41 million people had valvular heart disease in 2019.<sup>2</sup> Of these, 9.4 million had calcific aortic stenosis,<sup>2</sup> a slowly progressing disorder that worsens with age and can lead to severe aortic stenosis (a damaged aortic valve).<sup>3</sup>

3% of adults over the age of 65 have aortic stenosis, a life-threatening condition treatable with aortic valve replacement.<sup>4</sup>

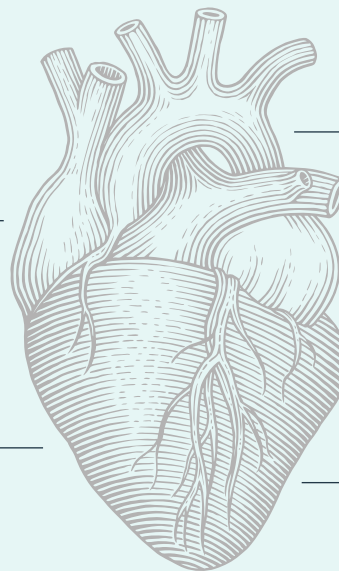
Figure 1: Aortic stenosis prevalence by age group<sup>5</sup>



## Aortic stenosis has many health-related complications, including:<sup>6-15</sup>

Bleeding tendency, including chronic gastrointestinal bleeding

Infection of the heart chamber and valves (endocarditis)



Heart failure

Sudden cardiac death

Irregular heartbeat (arrhythmias)

## Saudi Arabia

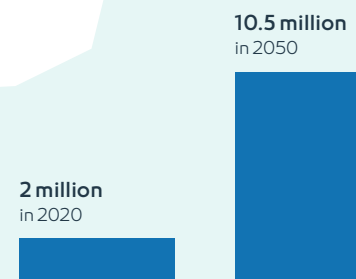
The prevalence of aortic stenosis is expected to increase as life expectancy rises in the population.<sup>16</sup>

– 2-7% is the estimated prevalence of aortic stenosis in Saudi Arabia in people over 60, based on comparable high-income countries.<sup>17-19</sup> Definitive population studies are needed to accurately assess the size of the treatable population with severe aortic stenosis in Saudi Arabia and elsewhere.<sup>20</sup>

Currently, many symptomatic aortic stenosis cases in Saudi Arabia go undiagnosed and unreported.<sup>21</sup>

A five-fold increase is expected by 2050<sup>22</sup>

Figure 2: Predicted increase in Saudi Arabia's elderly population (60+ years) by 2050





# The hidden health crises impacting Saudi Arabia's older population

VHD, commonly referred to as a “silent pandemic,” is often overshadowed by other cardiovascular diseases. It is frequently overlooked and untreated, even though there are effective treatment options readily available.

Neglecting to treat VHD in older people leads to life-threatening and expensive complications. Without intervention, the impact of VHD is predicted to rise due to the increasing incidence of the disease among the aging Saudi population.

## Degenerative VHD is a significant health issue with profound implications for older populations.

However, diagnosis rates remain alarmingly low, leading to underprioritization of VHD as a health care concern in Saudi Arabia. Consequently, there is a lack of comprehensive data reflecting this condition's true prevalence and financial burden.

## Failure to diagnose and provide timely treatment for VHD leads to increased morbidity, mortality, and health care costs.<sup>23,24</sup>

Despite being treatable, VHD often goes unnoticed due to a lack of awareness about the disease and its symptoms. This can result in serious complications, such as heart failure and stroke, which are not only detrimental to individuals but also impose substantial financial strains on health care systems.<sup>24-26</sup>

## Aortic stenosis, the most common form of VHD in elderly individuals in developed nations, is associated with several health complications.

Adverse outcomes include heart failure, pulmonary hypertension, sudden cardiac death, arrhythmias, endocarditis, and increased bleeding tendencies.<sup>6,8-15,27</sup> If left untreated, severe symptomatic cases of aortic stenosis have a high mortality rate within two years.<sup>7</sup>

## Degenerative calcific aortic valve stenosis is becoming a growing concern in Saudi Arabia, particularly in individuals over the age of 60.<sup>5</sup>

Evidence from other high-income countries suggests that, in cases of moderate and severe VHD, severe aortic stenosis is notably common in those aged 75 years and over.<sup>5,17</sup> As the Saudi population ages, the importance of detecting and managing degenerative diseases such as VHD becomes paramount.<sup>22,28</sup> Failing to acknowledge this demographic trend and establish comprehensive systems and policies to address it will have long-lasting health and economic consequences.<sup>29</sup>

## Investing in better detection of VHD will enable adequate care and alleviate the burden on individuals, families, and societies – saving costs in the long run.

Effective treatments for VHD already exist, but low diagnosis rates limit their potential to reduce the impact of the disease. Systematic screening of people over the age of 60 will ensure that patients are connected to life-saving treatments. Timely treatment intervention will also prevent costly complications of VHD, reducing health-care costs, as well as indirect costs due to poor health and mortality.<sup>30</sup>



**50%**

of patients with aortic stenosis who go untreated do not survive more than two years after the onset of symptoms.<sup>6</sup>

# What is valvular heart disease?

VHD is caused by damage to the heart valves. Damage can result from aging, known as degenerative VHD, of which aortic stenosis is the leading cause of illness and death.

Aortic stenosis, and aortic and mitral valve regurgitation are the most common forms of degenerative VHD, although any heart valve can be affected.<sup>31,32</sup> Other causes of VHD not related to aging include a congenital birth defect or an infection (rheumatic heart disease\*).

## Symptoms and complications

VHD makes it harder for the heart to circulate blood through the body and can lead to irregular heartbeat, heart attacks, and cardiac arrest.<sup>31</sup> VHDs are also major causes of acute and chronic heart failure.<sup>33</sup> VHD causes reduced cardiac performance, leading to an insufficient supply of blood and oxygen to the organs and tissues. This can lead to feelings of dizziness, blackouts, and fatigue.<sup>30</sup> People with aortic stenosis may not have these symptoms. However, decline in routine physical activities, heart palpitations, shortness of breath when inactive, and significant fatigue are telltale symptoms.<sup>30,34-36</sup> Other common symptoms are difficulty breathing and a feeling of heaviness in the chest.<sup>30,34-36</sup>

Due to a lack of awareness about VHD, these symptoms are frequently misattributed to old age, thus leaving the underlying condition untreated.<sup>30</sup> Untreated, VHD can lead to symptomatic complications, including heart failure, stroke, blood clots and irregular heartbeats.<sup>30</sup> These complications are significant causes of disability and death in Saudi Arabia and the world.<sup>37</sup> Complications are preventable if the condition is diagnosed in time,

enabling individuals to live a healthy and full life that meets a normal expectancy of up to 80 years old.

## Detection and diagnosis

VHD can be detected using a stethoscope to listen for any abnormal heart sounds, known as a cardiac murmur. If a murmur is detected, the HCP refers the patient for an echocardiogram, an ultrasound that checks the heart's structure and function. This non-invasive procedure is the most frequently employed method for evaluating and monitoring VHD.<sup>30</sup>

## Treatment

Different treatment options are available for treating VHD, depending on various factors, such as the symptoms experienced, the severity of the condition, and the progression of the disease. Severe aortic stenosis is a life-threatening condition, but it can be treated by replacing the heart valve, and individuals can expect to have a normal life expectancy.

In the past, elderly patients with severe symptomatic aortic stenosis and underlying health conditions were often denied surgical aortic valve replacement (SAVR) due to the high mortality rate associated with the procedure.<sup>16</sup> However, advancements in medical technology have introduced minimally invasive treatments such as transcatheter aortic valve replacement (TAVR), also known as transcatheter aortic valve implan-

---

\* Rheumatic heart disease results from permanent heart valve damage caused by rheumatic fever.<sup>40</sup> The fever arises from inflammation due to an infection with group A streptococcus bacteria.<sup>39</sup> If left untreated, it can cause permanent heart valve damage and other serious health problems.<sup>40</sup> Children and teenagers are particularly vulnerable. While antibiotic treatment is recommended and can prevent permanent heart valve damage, lack of knowledge and awareness inhibits effective prevention, particularly in remote areas.<sup>41,42</sup> The prevalence of rheumatic heart disease is high in Saudi Arabia and it remains a significant public health concern.<sup>42</sup>

tation (TAVI).<sup>38</sup> These treatments involve replacing a thickened aortic valve without major surgery and with minimal discomfort to the patient.

TAVR is now frequently recommended for patients with severe aortic stenosis due to its quicker recovery period and shorter hospital stays than invasive surgical alternatives.<sup>39</sup> Recent research from Saudi Arabia shows that TAVR is associated with lower direct costs than open-heart surgery over a five-year horizon for high- and intermediate-risk patients and equal direct costs for low-risk patients.<sup>39</sup> This means



**80%**

of patients undergoing intervention for aortic stenosis in Saudi Arabia had hypertension and high cholesterol, which put individuals at risk of serious cardiac events.<sup>45</sup>

that TAVR provides better patient outcomes and is a more affordable treatment option.



### Degenerative VHD

Degenerative aortic valve disease is a condition that develops progressively due to the wear and tear associated with aging. The structural integrity of the heart valves weakens as collagen fibers break down and calcium deposits accumulate, causing valve leaflets to thicken, stiffen, or function poorly. Most people with degenerative aortic valve disease only have a mild thickening and normal valve function called aortic sclerosis. A small percentage, however, have significant aortic stenosis with restricted flow of blood from the left ventricle; if not addressed, this may lead to heart failure.<sup>43,44</sup>

Timely medical intervention is pivotal in managing degenerative VHD and enhancing patients' quality of life. Diagnosis rates could be improved by systematically screening patients with high risk of VHD, including those living with obesity, high cholesterol, and hypertension. Public awareness and routine cardiovascular check-ups are essential, particularly as the Saudi population continues to age.

# Why are people with valvular heart disease in Saudi Arabia not getting treated?

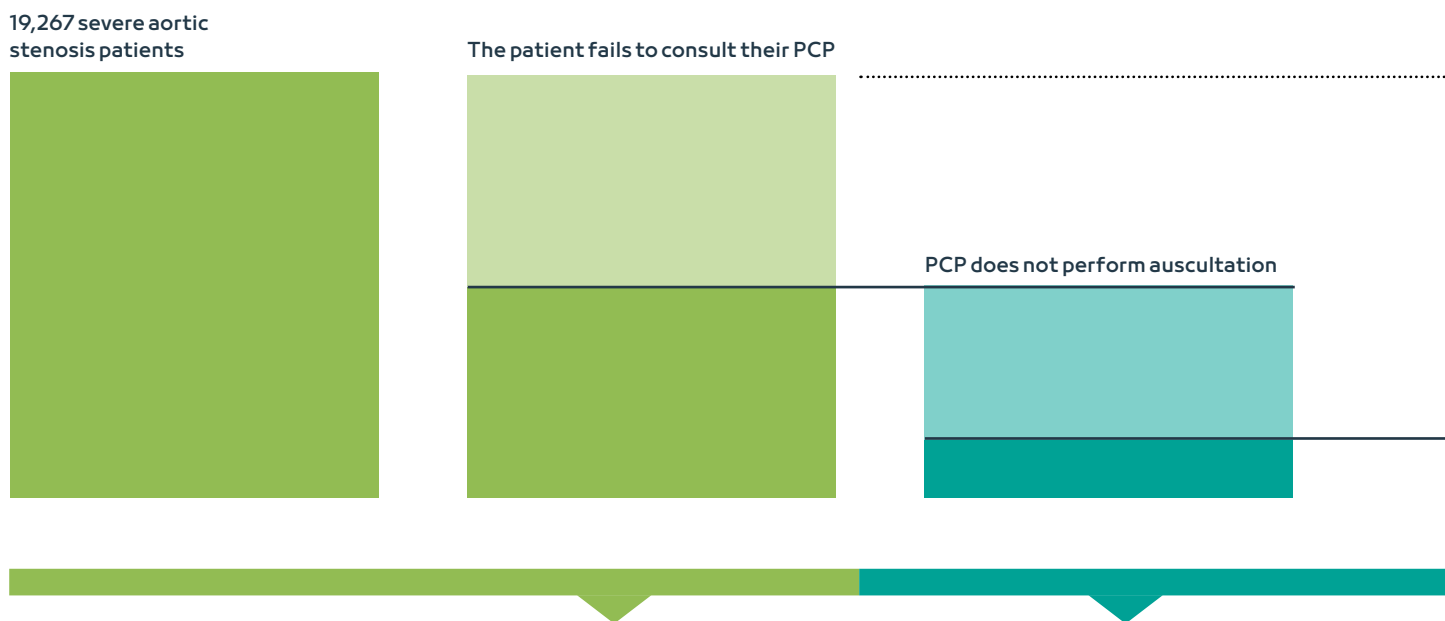
Effective treatment is available, yet – despite a growing older population in Saudi Arabia – very few people receive aortic valve replacement annually.

The low number of patients treated annually in Saudi Arabia hints at missed opportunities and gaps in patient care, causing undetected and insufficiently treated degenerative VHD. A model was developed to estimate the burden of severe symptomatic aortic stenosis in the local population, using market-related data on treat-

ment to better understand where patients “drop off” along the care pathway (*Figure 3*).

The patient drop-off demonstrates the urgent need for improvements in the health system to ensure that all patients with aortic stenosis receive the care they require.

**Figure 3:** The drop-off of patients with severe symptomatic aortic stenosis indicates the need for improved awareness, detection, and diagnosis in Saudi Arabia



## Missed opportunities

Patients and their families fail to seek help, as they believe that their symptoms relate to natural aging.

The patient’s doctor or PCP fails to perform auscultation, thus missing the opportunity to diagnose aortic stenosis during a consultation.

## The model illustrates that:

Around **20,000** people over the age of 65 years are estimated to live with symptoms of severe aortic stenosis in Saudi Arabia.\*

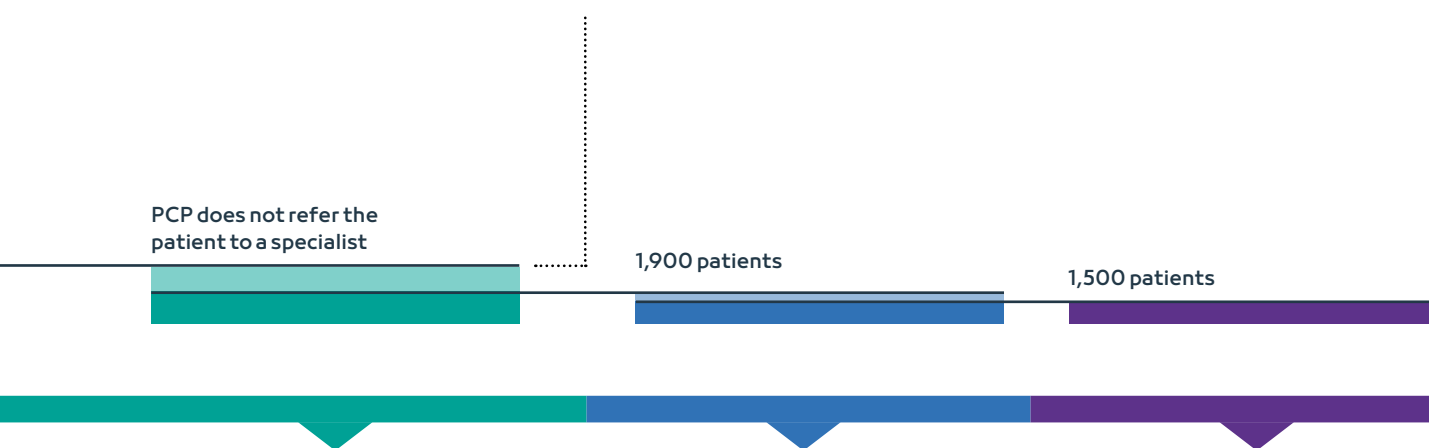
Each year, around **1,900 patients** are referred by PCPs for diagnosis of a suspected heart murmur.\*\* This indicates that a significant proportion of symptomatic severe aortic

stenosis patients living with symptoms go unnoticed, or are not recognized as having VHD, or remain undetected by their doctor.<sup>21</sup>

**Only 1,500** of the estimated elderly population with symptomatic severe aortic stenosis receive an aortic valve replacement annually.\*\* This is merely a fraction of people with aortic stenosis in the country.

### 90% of patients drop off before reaching the specialist care

required to provide them with the treatment to reverse their condition



The PCP performs the auscultation but does not refer the patient to a specialist to confirm the suspected diagnosis.

\* Calculated based on published population figures ( $\geq 65$  years Saudi nationals/non-nationals) and global prevalence data.<sup>46,47</sup> A prevalence range of 1.7% to 2.6% has been factored into the analyses as a plausible estimate based on available literature. However, this range likely underestimates the true prevalence within the Saudi population. This underestimation is due to the high prevalence of comorbidities such as hypertension, dyslipidemia, diabetes, and obesity in Saudi Arabia, which are known to contribute to accelerated calcification of the aortic valve. Population-based epidemiological studies are critical to obtain more accurate estimates on the prevalence of severe aortic stenosis in Saudi Arabia. \*\* These estimates have been calculated based on expert opinion.

# Opportunities for improving patient care for aortic stenosis in primary care

## Heart auscultation

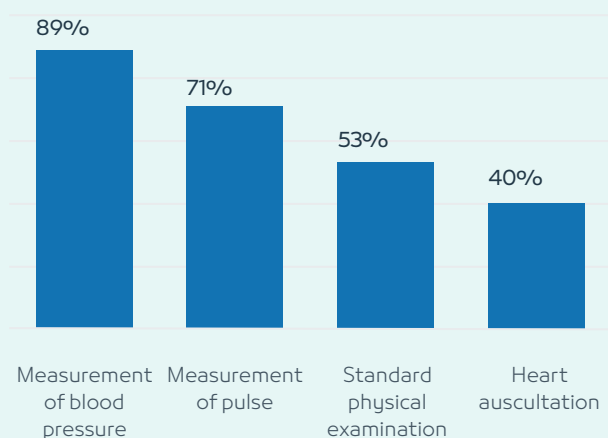
Guidelines and recommendations on managing and treating VHD are critical for ensuring care for people with severe aortic stenosis. Heart auscultation should be part of standard check-ups, and PCPs must have the skills to auscultate patients.

- All respondents acknowledge the importance of having local guidelines/recommendations for identifying patient profiles for heart auscultation and managing patients with a heart murmur.
- 76% of respondents agree that heart auscultation should be part of the standard check-up for patients over 65 years old (although only around 40% of respondents currently auscultate most of their elderly patients).

## Heart auscultation is not a routinely performed test

- Only 40% of the respondents mentioned that they routinely auscultate patients over 65. In comparison, almost 90% of the respondents regularly measure blood pressure in their elderly patients.

Figure 4: Frequency of check-up procedures

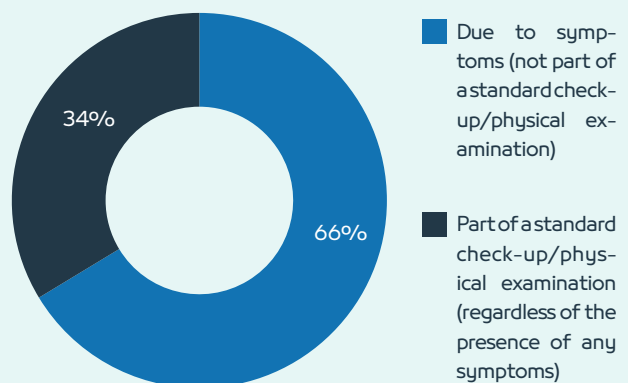


## Symptoms are the main reason for performing heart auscultation

On average,

- 66% of elderly patients are auscultated because of the presence of certain symptoms, namely palpitations, chest pain, or shortness of breath. This highlights the importance of ensuring that patients, their families, and PCPs are familiar with the symptoms of VHD.
- 34% of elderly patients are auscultated as part of a standard check-up/physical examination (regardless of the presence of any symptoms).

Figure 5: Heart auscultation



## About the survey

70 PCPs in Saudi Arabia participated in an electronic survey to assess their comprehension of aortic stenosis, encompassing knowledge regarding symptoms, prevalence among patients and the severity of the disease.<sup>48</sup>

## Respondent characteristics:

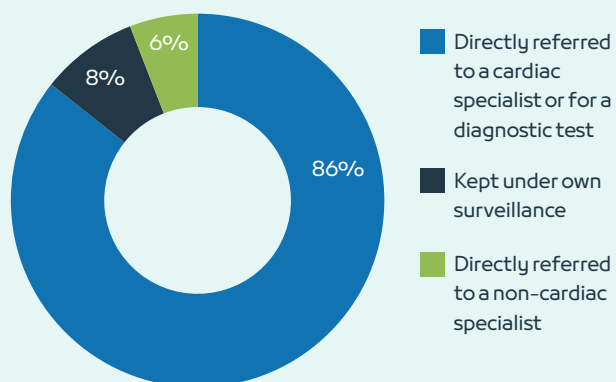
- Experience ranged from 5 to 20+ years
- 89% based in Riyadh
- 71% based at a primary care center
- 22% based at Medical City
- 4% working in a specialized or tertiary care hospital or involved with home care

## Referral after detecting a murmur

Clear referral pathways are essential for ensuring that elderly patients with detected heart murmurs receive timely and coordinated care from appropriate specialists, ultimately improving clinical outcomes and quality of life.

The majority of respondents report referring elderly patients for a diagnostic test (electrocardiogram or echocardiogram) or to a cardiac specialist for further investigation when a heart murmur is detected.

Figure 6: Referral of patients with detected heart murmur



## Around 14% of elderly patients with a heart murmur will not be referred to a cardiologist or for a diagnostic test.

Reasons for not referring a patient include: unclear referral network, patient's personal preference, and long waiting time for referral.

Around 6% of patients with a heart murmur are referred to a non-cardiac specialist. Typically, these are patients who suffer from other comorbidities or patients who are already followed up by a cardiologist due to a previously detected heart murmur.

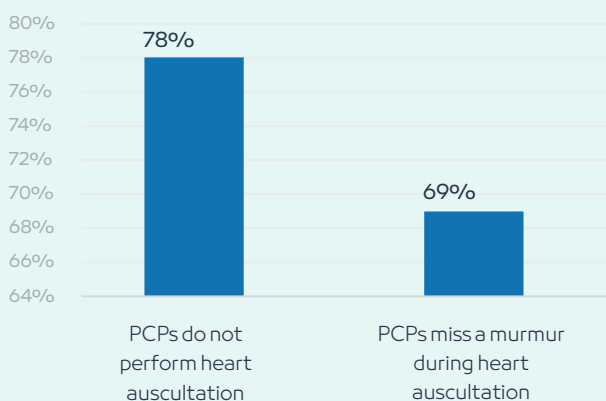
## Severe aortic stenosis

Annual check-ups play a crucial role in the management of patients with asymptomatic aortic stenosis by facilitating monitoring of disease progression, early detection of symptoms, risk assessment, and coordination of care.

Respondents suggest that asymptomatic patients with severe aortic stenosis should have a yearly check-up with a cardiologist, ideally every six months, and should undergo an electrocardiogram or echocardiogram annually.

- **80%** of respondents agree that there is a **low awareness of aortic stenosis among patients and caregivers** about the disease and its symptoms and that there is underdiagnosis and undertreatment of patients over 65 years suffering from severe aortic stenosis.
- **One in three** respondents were unsure about how to categorize or assess the seriousness of a patient's aortic stenosis.
- **One in four** respondents believe they do not have enough knowledge about the available interventions (SAVR, TAVI) for treating severe aortic stenosis.

Figure 7: The main reasons for underdiagnosis of severe aortic stenosis are connected with PCPs



# Barriers to care and missed opportunities for intervention

The burden of VHD in Saudi Arabia can be significantly reduced by addressing current gaps in patient care and the barriers that lead to these missed opportunities for timely diagnosis, referral that links to treatment, and optimal disease management.

## 1. Poor public awareness prevents individuals with symptoms from seeking a diagnosis or pursuing treatment

There is a lack of awareness among the Saudi public regarding VHD and its related symptoms. This knowledge gap, combined with misconceptions about the effects of aging, often results in the dismissal of early warning signs such as fatigue, shortness of breath, faintness, and other symptoms by both patients and HCPs.<sup>49,50</sup>

## 2. Lack of epidemiological data results in under-recognition of VHD

There is a lack of national data regarding the occurrence of aortic stenosis and degenerative VHD in Saudi Arabia. Even at a global level, epidemiological data is scarce. The condition suffers from inadequate detection and under-reporting, which leads to a lack of public recognition and insufficient prioritization within the health care system. This issue is particularly evident in policies and practices concerning individuals aged 60 and above.

## 3. PCPs lack sufficient awareness, resulting in a failure to accurately diagnose VHD in a timely manner

For treatment to be effective, it is essential to have an accurate and prompt diagnosis of VHD.<sup>30</sup> Failure to diagnose VHD can be linked to a lack of awareness and knowledge gaps among PCPs, which can have fatal consequences for patients. VHD is not

commonly encountered in primary care practices in Saudi Arabia. This rarity of VHD cases may lead to a lack of confidence among PCPs in accurately identifying and diagnosing the condition, especially when a heart murmur is present.

## 4. PCPs often do not perform cardiac auscultations

VHD can be detected by listening for a heart murmur. Auscultation is an inexpensive and non-invasive tool for detecting heart murmurs. However, in many countries fewer than one quarter of PCPs regularly carry out this simple check in people over 60.<sup>51,52</sup> PCPs encounter multiple challenges that deter thorough examinations in their busy practices. For example, examining the chest may require patients to partially disrobe, which can be uncomfortable for women and pose practical difficulties for overweight individuals. Inaccurate diagnostic equipment further complicates accurate auscultations for PCPs in Saudi Arabia.

## 5. Routine screening for VHD is underutilized in primary care

In Saudi Arabia, heart auscultation in older adults is not recommended as a routine check.<sup>21</sup> Local experts report that most patients with aortic stenosis are identified as severe and symptomatic at a late stage, and many people in remote regions are not being identified at all. Time constraints with each patient can worsen the challenges doctors face in delivering comprehensive care, including routine check-ups.



## 6. The health system set-up delays the practice of routine screening in primary care

In Saudi Arabia, PCPs often face challenges in maintaining continuity of care for their patients. It is common for patients to be assigned to different PCPs in subsequent sessions, which makes it difficult to track and manage their health care needs effectively. Furthermore, patients can seek medical services from various locations, and some may even bypass primary care entirely. Consequently, doctors may encounter difficulties in staying informed about their patient's symptoms and scheduling timely check-ups.

## 7. Clinical guidelines on the management of VHD and treatment pathway options are not available

In Saudi Arabia, there are currently no standardized protocols or guidelines on VHD treatment and management for HCPs to follow. HCPs rely on international guidelines for treating and managing patients with VHD, including aortic stenosis.

## 8. Referral pathways for echocardiograms can be unclear for health care providers

Access to echocardiography is crucial for managing valvular diseases in the community.<sup>30</sup> However, it is common for patients to experience delays in accessing these tests, leading to delays in both diagnosis and treatment.<sup>23</sup> This delay is influenced by factors



**1 in 3**

people with aortic stenosis go undetected because they never go to a primary care doctor to discuss their concerns.<sup>21</sup>

such as insufficient knowledge or clear guidelines for referring patients for an echocardiogram, even after detecting a heart murmur.<sup>53</sup> Additionally, even after undergoing an echocardiogram, patients may not be provided with recommendations for regular monitoring by a cardiologist.<sup>54</sup>

## 9. Echocardiogram evaluations are not accurately performed

To accurately perform an echocardiogram, it is crucial to have a skilled and knowledgeable technician or specialist in imaging.<sup>55</sup> In Saudi Arabia, the under-reporting of aortic stenosis may, in part, be attributed to the lack of expertise among technicians in accurately conducting echocardiograms. Therefore, there is a need for additional training in this area. Additionally, there is an opportunity to enhance support for technicians and physicians in evaluating, diagnosing, and managing aortic stenosis by providing access to remote virtual healthcare services.



**Valvular heart disease, compared to other diseases, isn't well-recognized among the scientific and professional community.** There's a lack of knowledge about the disease prevalence, its burden, and the importance of early prevention strategies and treatment plans within current practice.

### Dr Hussain Al-Omar

Associate Professor of Pharmacoeconomics and Director of the Health Technology Assessment Unit, King Saud University (KSU)



# Policy recommendations

The types of barriers identified as preventing individuals with VHD in Saudi Arabia from accessing treatment suggest three priority areas where policy action can be taken. Several recommendations have been determined for each area that could improve the patient journey.

## Raise awareness among the public and HCPs

**Raise public awareness of VHD symptoms** to avoid misattribution of symptoms to old age and ensure that people know when to seek care. This can be achieved through targeted educational campaigns and outreach programs for at-risk populations, particularly the elderly. These can be supported by cardiologists increasing their efforts to reach patients within their communities by going out to the community.

**Improve understanding of VHD in the medical profession** by integrating VHD into medical curricula and providing continued training, particularly for PCPs, to enable timely detection of VHD through routine screening and auscultation of elderly patients.

**Support epidemiological research** to inform health policy. Funding studies on the prevalence of VHDs such as aortic stenosis can provide vital data to guide health policy development. This includes tailoring awareness campaigns and medical education programs and optimizing resource allocation for treatment services based on population needs.

## Ensure timely diagnosis

**Invest in and conduct routine screenings at all levels of care** to ensure timely diagnosis of VHD and linkage to care. Incentivize screening in primary care by incorporating auscultation of older patients into

standard protocols and performance metrics. At higher levels of care, conduct routine ECGs for elderly patients who have bypassed primary care. Payers could also create financial incentives to improve detection rates.

**Equip primary care HCPs with the knowledge and skills** required to conduct echocardiograms. Technicians must be trained to perform this task effectively and be provided with access to centers that can support them remotely with reading echocardiograms.

**Implement referral protocols** for echocardiography to enable prompt diagnosis and linkage to care when heart murmurs are detected in primary care. Standardization expedites diagnosis and treatment while enhancing coordination between primary care and cardiology.

**Enable collaboration with cardiologists** to enhance clinical knowledge of heart conditions at the primary care level and allow PCPs to consult specialists. This can be achieved by providing cardiology training for PCPs at cardiac centers and providing them with direct contact details of specialists.

**Enable cardiologists to access remote support** via virtual hospitals that gives them the capability to evaluate a cardiac computed tomography (CT) scan and set up a suitable treatment plan, including awareness of three-dimensional (3D) model printing services, if needed, for challenging TAVI cases.

**Improve accessibility** by establishing satellite diagnostic facilities and mobile screening units. Public screening campaigns will improve disease awareness and diagnosis rates, and provide valuable epidemiological data.

## Improve disease management

**Establish a clear workforce plan** to ensure that the right skills and resources are available at each level of the health system. The plan must identify the type and quantity of needed resources, which are to be communicated to health care providers and decision-makers.

**Ensure prompt access to treatment and follow-up care** after diagnosis by establishing clear care pathways and monitoring systems. This enables appropriate ongoing management. Ensure

that HCPs in secondary care have access to the appropriate technologies and equipment to provide the support needed.

**Leverage digital platforms and systems** to enable regular patient follow-ups and improve care coordination. Digital platforms can be used to send screening reminders, ensure regular follow-ups and enable remote monitoring. Centralized patient records and digital information sharing will also improve care by facilitating the tracking of symptoms and coordination between providers.

**Implement integrated, multidisciplinary care teams** to provide comprehensive care for patients. Collaboration between specialists and across all levels of care enhances diagnosis accuracy, refines interventions, and provides continuous, well-rounded care.

---

## Conclusion

Degenerative VHD is a serious and growing health concern in Saudi Arabia's population as it ages, but it is treatable and preventable. We must do more to raise awareness of VHD, diagnose it early, and

provide treatment to those needing it. Addressing the needs of an aging population aligns with Saudi Vision 2030's goal of improving health care and creating a healthier society.

### Specifically, the following policy actions are recommended:



#### Raise awareness of VHD among the public and HCPs

This can be done through public education campaigns, training programs for health care workers, and support for research on VHD.



#### Ensure timely diagnosis and clear referral pathways

This can be done by increasing the availability of diagnostic tools and treatment facilities, and by providing financial assistance to patients who need VHD surgery.



#### Improve disease management

This can be done by developing clinical guidelines for VHD diagnosis and treatment, and by training more HCPs in VHD care.

## Glossary

**Aortic stenosis (AS)** is a heart condition in which the opening of the aortic valve narrows, limiting the blood flow from the heart to the rest of the body. It is typically caused by the thickening and stiffening of the valve leaflets. Aortic stenosis can lead to symptoms such as chest pain, fainting, and shortness of breath.

**Arrhythmia** refers to an abnormal heart rhythm. It is a condition characterized by an irregular, too fast, or too slow heartbeat.

**Auscultation** is a diagnostic technique used by health care professionals to listen to the sounds within the body, particularly the heart and lungs, using a stethoscope.

**Calcific aortic stenosis (CAS)** refers to the build-up of calcium deposits on the aortic valve leaflets, causing the valve to become narrowed and potentially obstruct blood flow through the valve. It is a degenerative condition typically associated with aging.

**Calcific aortic valve disease (CAVD)** is a progressive condition characterized by the accumulation of calcium deposits on the aortic valve leaflets. It can lead to aortic stenosis and other complications, impairing the normal functioning of the valve.

**Cardiac death** refers to the sudden, unexpected loss of heart function leading to immediate death. It can result from various causes such as arrhythmias, heart attacks, or other cardiac events.

**Degenerative valvular heart disease** refers to the progressive deterioration and dysfunction of heart valves over time. It can affect valves such as the aortic valve, mitral valve, tricuspid valve, or pulmonary valve, leading to symptoms and complications.

An **echocardiogram** is a non-invasive diagnostic test that uses ultrasound waves to create images of the heart's structure and function. It provides valuable information about the heart's chambers, valves, and blood flow, allowing health care professionals to assess and diagnose various heart conditions.

**Endocarditis** is an infection of the inner lining of the heart, including the heart valves. It can occur when bacteria, viruses, or fungi enter the bloodstream and attach to damaged areas of the heart, leading to inflammation and potentially damaging the heart valves.

**Heart failure** is a condition in which the heart is unable to pump enough blood to meet the body's demands. It can result from various underlying heart conditions, such as coronary artery disease, high blood pressure, or valvular heart disease.

A **heart murmur** is an abnormal sound heard during auscultation of the heart. It can indicate turbulent blood flow through the heart valves, potentially caused by valve abnormalities or other heart conditions. Heart murmurs are often identified during routine physical examinations and may require further evaluation.

**Hypertension**, also known as high blood pressure, is a condition characterized by elevated blood pressure levels. It can increase the workload of the heart and blood vessels, potentially leading to various cardiovascular complications, including valvular heart disease.

The **mitral valve** is one of the four valves in the heart and is situated between the left atrium and the left ventricle. The mitral valve plays a vital role in preventing the backflow of blood into the atrium when the ventricle contracts.

**Obesity** is a condition in which there is an excessive accumulation of body fat, often resulting in an increased body mass index (BMI). Obesity is associated with an increased risk of various cardiovascular conditions, including valvular heart disease, due to the added strain on the heart and blood vessels.

**Pulmonary hypertension** is a type of high blood pressure that affects the arteries in the lungs. It occurs when the blood vessels in the lungs become narrowed, blocked, or damaged, leading to increased pressure.

**Rheumatic fever** is an inflammatory condition that can occur as a complication of inadequately treated strep throat or scarlet fever infections. It primarily affects the joints, heart, skin, and nervous system.

**Rheumatic heart disease** is a condition that arises as a result of rheumatic fever. It occurs when the inflammatory process caused by rheumatic fever damages the heart valves, resulting in valve dysfunction.

**Surgical aortic valve replacement (SAVR)** is a surgical procedure that involves replacing a damaged or diseased aortic valve with a prosthetic valve.

**Transcatheter aortic valve implantation (TAVI)**, also known as transcatheter aortic valve replacement (TAVR), is a minimally invasive surgical procedure used to replace a diseased aortic valve.

**Valvular heart disease (VHD)** refers to abnormalities or dysfunctions in one or more of the heart valves, including the aortic valve, mitral valve, tricuspid valve, or pulmonary valve. It can involve conditions such as stenosis (narrowing), regurgitation (leaking), or a combination of both.

# References

1. Lindman BR, Clavel MA, Mathieu P, et al. Calcific aortic stenosis. *Nat Rev Dis Primers*. Mar 3 2016;2:16006. doi:10.1038/nrdp.2016.6
2. Coffey S, Roberts-Thomson R, Brown A, et al. Global epidemiology of valvular heart disease. *Nature Reviews Cardiology*. 2021;18(12):853–864.
3. Nishimura RA, Otto CM, Bonow RO, et al. 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. Jun 10 2014;63(22):e57–185. doi:10.1016/j.jacc.2014.02.536
4. Lindroos M, Kupari M, Heikkilä J, Tilvis R. Prevalence of aortic valve abnormalities in the elderly: an echocardiographic study of a random population sample. *J Am Coll Cardiol*. Apr 1993;21(5):1220–5. doi:10.1016/0735-1097(93)90249-z
5. Ancona, R. Pinto, SC. Epidemiology of aortic valve stenosis (AS) and of aortic valve incompetence (AI): is the prevalence of AS/AI similar in different parts of the world? *e-Journal of Cardiology Practice*. 2020;18
6. Otto CM. Timing of aortic valve surgery. *Heart*. 2000;84(2):211–218.
7. Ng ACT, Prihadi EA, Antoni ML, et al. Left ventricular global longitudinal strain is predictive of all-cause mortality independent of aortic stenosis severity and ejection fraction. *Eur Heart J Cardiovasc Imaging*. Aug 1 2018;19(8):859–867. doi:10.1093/ehjci/jex189
8. Klæboe LG, Haland TF, Leren IS, et al. Prognostic Value of Left Ventricular Deformation Parameters in Patients with Severe Aortic Stenosis: A Pilot Study of the Usefulness of Strain Echocardiography. *J Am Soc Echocardiogr*. Aug 2017;30(8):727–735.e1. doi:10.1016/j.echo.2017.04.009
9. Taniguchi T, Morimoto T, Shiomi H, et al. Sudden Death in Patients With Severe Aortic Stenosis: Observations From the CURRENT AS Registry. *J Am Heart Assoc*. May 18 2018;7(11) doi:10.1161/jaha.117.008397
10. Hudzik B, Wilczek K, Gasior M. Heyde syndrome: gastrointestinal bleeding and aortic stenosis. *Cmaj*. Feb 2 2016;188(2):135–138. doi:10.1503/cmaj.150194
11. Stortecky S, Buellesfeld L, Wenaweser P, et al. Atrial fibrillation and aortic stenosis: impact on clinical outcomes among patients undergoing transcatheter aortic valve implantation. *Circ Cardiovasc Interv*. Feb 2013;6(1):77–84. doi:10.1161/circinterventions.112.000124
12. Faggiano P, Antonini-Canterin F, Ribichini F, et al. Pulmonary artery hypertension in adult patients with symptomatic valvular aortic stenosis. *Am J Cardiol*. Jan 15 2000;85(2):204–8. doi:10.1016/s0002-9149(99)00643-8
13. Gersony WM, Hayes CJ, Driscoll DJ, et al. Bacterial endocarditis in patients with aortic stenosis, pulmonary stenosis, or ventricular septal defect. *Circulation*. Feb 1993;87(2 Suppl):I121–6.
14. Alasnag M, AlMerri K, Almoghairi A, et al. One-Year Outcomes for Patients Undergoing Transcatheter Aortic Valve Replacement: The Gulf TAVR Registry. *Cardiovasc Revasc Med*. 2022;41:19–26.
15. Alasnag M, Alanazi N, Al-Sheikh S, et al. WIN Gulf TAVR Registry: Describing Sex Differences in Patient Characteristics, Prognosis, and Outcomes. *JSCAI*. 2022;doi:10.1016/j.jscai.2022.100509
16. Alatawi FO, Abuelatta RA, AlAhmedi AB, et al. Clinical outcomes with transcatheter aortic valve implantation at a single cardiac center in Saudi Arabia. *Annals of Saudi medicine*. 2018;38(3):167–173.
17. Nkomo VT, Gardin JM, Skelton TN, Gottdiener JS, Scott CG, Enriquez-Sarano M. Burden of valvular heart diseases: a population-based study. *Lancet (London, England)*. Sep 16 2006;368(9540):1005–11. doi:10.1016/S0140-6736(06)69208-8
18. De Sciscio P, Brubert J, De Sciscio M, Serrani M, Stasiak J, Moggridge GD. Quantifying the shift toward transcatheter aortic valve replacement in low-risk patients: a meta-analysis. *Circulation: Cardiovascular Quality and Outcomes*. 2017;10(6):e003287.
19. Lung B, Vahanian A. Epidemiology of acquired valvular heart disease. *Can J Cardiol*. Sep 2014;30(9):962–70. doi:10.1016/j.cjca.2014.03.022
20. Strange GA, Stewart S, Curzen N, et al. Uncovering the treatable burden of severe aortic stenosis in the UK. *Open Heart*. Jan 2022;9(1)doi:10.1136/openhrt-2021-001783
21. IPSOS. AS Patient Drop-off KSA. 2020.
22. UNFPA and HelpAge International. Country profile: The rights and wellbeing of older persons in Saudi Arabia. 2015. [https://arabstates.unfpa.org/sites/default/files/pub-pdf/country\\_profile\\_-\\_saudia\\_27-10-2021.pdf](https://arabstates.unfpa.org/sites/default/files/pub-pdf/country_profile_-_saudia_27-10-2021.pdf)
23. Harding E BK, Morris T, et al. Heart valve disease: working together to create a better patient journey. 2022.
24. Tarride J-E, Lauck S, Natarajan MK, Asgar AW, Luong T, Blackhouse G. One-year costs associated with hospitalizations due to aortic stenosis in Canada. *CJC open*. 2021;3(1):82–90.
25. Clark MA, Arnold SV, Duhay FG, et al. Five-year clinical and economic outcomes among patients with medically managed severe aortic stenosis: results from a Medicare claims analysis. *Circulation: Cardiovascular Quality and Outcomes*. 2012;5(5):697–704.
26. Trochu J-N, Le Tourneau T, Obadia J-F, Caranhac G, Beresniak A. Economic burden of functional and organic mitral valve regurgitation. *Archives of cardiovascular diseases*. 2015;108(2):88–96.
27. Rainò E, Rapalino M, Morabito A. [Epidemiologic study in a Turin high-school]. *Minerva Stomatol*. Jun 1988;37(6):505–6. *Indagine epidemiologica in una scuola media di Torino*.
28. Rostagno C. Heart valve disease in elderly. *World journal of cardiology*. 2019;11(2):71.
29. Messika-Zeitoun D, Baumgartner H, Burwash IG, et al. Unmet needs in valvular heart disease. *European heart journal*. 2023;doi:10.1093/eurheartj/ehad121
30. Marwick TH, Gall S, Buscut M, et al. *Our Hidden Ageing: Time to Listen to the Heart*. 2018.

31. Centers for Disease Control and Prevention. *Valvular Heart Disease*. Accessed June, 2023. [https://www.cdc.gov/heart-disease/valvular\\_disease.htm#:~:text=If%20the%20heart%20valves%20are,stops%20beating\)%2C%20and%20death.](https://www.cdc.gov/heart-disease/valvular_disease.htm#:~:text=If%20the%20heart%20valves%20are,stops%20beating)%2C%20and%20death.)
32. Lung B, Baron G, Butchart EG, et al. A prospective survey of patients with valvular heart disease in Europe: The Euro Heart Survey on Valvular Heart Disease. *European heart journal*. 2003;24(13):1231-1243. doi:10.1016/s0195-668x(03)00201-x
33. Baumgartner H, Falk V, Bax JJ, et al. 2017 ESC/EACTS Guidelines for the management of valvular heart disease The Task Force for the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). *European Journal of Cardio-Thoracic Surgery*.
34. American Heart Association. *Aortic Stenosis Overview*. Accessed July, 2023. <https://www.heart.org/en/health-topics/heart-valve-problems-and-disease/heart-valve-problems-and-causes/problem-aortic-valve-stenosis>
35. Asami M, Dobner S, Stortecy S, et al. Cardiovascular outcomes in patients with left atrial enlargement undergoing transcatheter aortic valve implantation. *Catheter Cardiovasc Interv*. May 2022;99(6):1908-1917. doi:10.1002/ccd.30132
36. Andreassen C, Gislason GH, Køber L, et al. *Incidence of ischemic stroke in individuals with and without aortic valve stenosis: a Danish retrospective cohort study*. *Stroke*. 2020;51(5):1364-1371.
37. AlHabeeb W, Al-Ayoubi F, AlGhalayini K, et al. Saudi Heart Association (SHA) guidelines for the management of heart failure. *Journal of the Saudi Heart Association*. 2019;31(4):204-253.
38. Mayo Clinic. *Transcatheter aortic valve replacement (TAVR)*. Accessed June, 2023. <https://www.mayoclinic.org/tests-procedures/transcatheter-aortic-valve-replacement/about/pac-20384698>
39. Carapinha JL, Al-Omar HA, Alqoofi F, Samargandy SA, Candolfi P. Budget impact analysis of transcatheter aortic valve replacement in low, intermediate, and high-risk patients with severe aortic stenosis in Saudi Arabia. *J Med Econ*. Dec 20 2021;1-16. doi:10.1080/13696998.2021.2020569
40. World Heart Federation. *Rheumatic Heart Disease*. Accessed July, 2023.
41. Cleveland Clinic. *Rheumatic Heart Disease*. Accessed July, 2023. <https://my.clevelandclinic.org/health/diseases/21485-rheumatic-heart-disease>
42. Almadhi AA, Alshammri MR, Altamimi NO, Hadal SA, Al Madhi AA, Salahie MS. Rheumatic Fever and Rheumatic Heart Disease-Related Knowledge, Attitude, and Practice in Saudi Arabia. *Cureus*. Nov 2021;13(11):e19997. doi:10.7759/cureus.19997
43. Bhatia N, Basra SS, Skolnick AH, Wenger NK. Aortic valve disease in the older adult. *Journal of Geriatric Cardiology: JGC*. 2016;13(12):941.
44. Martinsson A, Li X, Andersson C, Nilsson J, Smith JG, Sundquist K. Temporal trends in the incidence and prognosis of aortic stenosis: a nationwide study of the Swedish population. *Circulation*. Mar 17 2015;131(11):988-94. doi:10.1161/circulationaha.114.012906
45. Albugami S, Al-Husayni F, Alfouti M, et al. Self-Expandable Transcatheter Aortic Valve Implantation Outcomes: Findings From the Western Region of Saudi Arabia. *Cureus*. 2021;13(9)
46. Danielsen R, Aspelund T, Harris TB, Gudnason V. The prevalence of aortic stenosis in the elderly in Iceland and predictions for the coming decades: The AGES-Reykjavik study. *International journal of cardiology*. 2014;176(3):916-922.
47. General Authority for Statistics. <https://www.stats.gov.sa/en>
48. Edward Lifesciences. *Aortic Stenosis Survey for Primary Care Physicians results*. 2023.
49. Mikton C, de la Fuente-Núñez V, Officer A, Krug E. Ageism: a social determinant of health that has come of age. *The Lancet*. 2021;397(10282):1333-1334.
50. Eberstadt N. *Heart Valve Disease: Harnessing Innovation to Save Lives, Mitigate Costs, and Advance the Healthy Aging Agenda*. 2023;
51. Gaede L, Sitges M, Neil J, et al. European heart health survey 2019. *Clinical cardiology*. 2020;43(12):1539-1546.
52. Brennan MJ, Coylewright M, Ayo Vaughan M, Ganesan N. Bridging gaps in heart valve disease care: opportunities for quality improvement. *Catheterization and Cardiovascular Interventions*. 2019;94(2):289-293.
53. Morris AA, Khazanie P, Drazner MH, et al. Guidance for timely and appropriate referral of patients with advanced heart failure: a scientific statement from the American Heart Association. *Circulation*. 2021;144(15):e238-e250.
54. Kirby AM, Kruger B, Jain R, Daniel P, Granger BB. Using clinical decision support to improve referral rates in severe symptomatic aortic stenosis: a quality improvement initiative. *CIN: Computers, Informatics, Nursing*. 2018;36(11):525-529.
55. Chambers JB, Lancellotti P. Heart Valve Clinics, Centers, and Networks. *Cardiol Clin*. Feb 2020;38(1):65-74. doi:10.1016/j.ccl.2019.09.006



المجلس الصحي السعودي  
Saudi Health Council

المركز الوطني للقلب  
National Heart Center