



# Heart Valve Disease: System Level Recommendations for Integrated Care Delivery: A Spoke-Hub-Node model of care

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## About This Report

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## Introduction

Heart valve disease (HVD) is a significant and important part of cardiovascular disease yet often does not get as much attention as heart attack, heart failure or stroke although it may be directly responsible for such complications. HVD is multifaceted and very complex, and is an umbrella term that includes a wide variety of conditions affecting all the different valves of the heart. Valve disease treatment plans can be complex, with many factors determining who might be a candidate for medical therapy or valve repair/replacement.

It is important to remember the term HVD include a menagerie of complex cardiovascular pathologies and it is only through incorporating multidisciplinary approaches that the system will be able to address the variety of different heart valve diseases effectively. The Institute of Health Economics has been requested by the Canadian Cardiovascular Society to describe key components at a system level for delivering integrated primary care, specialist, and acute care for HVD in Canada.<sup>1</sup> This initiative builds on previous work to identify components of a national strategy for heart valve disease based on a national roundtable that convened in November 2021.<sup>2</sup>

The key recommendation from the 2021 report which has sparked this follow up work was:

“A variety of hub and spoke models for configuring care should be explored and tailored to regional circumstances that ensure referral pathways are clear, treatment is guideline directed, programs are cost-effective and centres are resourced to address demand in an equitable way across Canada.”<sup>3</sup>

This report provides some system level recommendations which build off of literature, survey and interviews. It also includes some examples from other areas of health care which provide some useful reference to advance changes in HVD.

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<sup>1</sup> Forcillo J, Wood DA, Abdel-Razek O, Adreak N, Asgar A, Chedrawy E, et al. A national strategy to detect and treat heart valve diseases in Canada. *Canadian Journal of Cardiology* 2023;10.1016/j.cjca.2023.01.021.

<sup>2</sup> Sproule J, Bond K, Warkentin L, Guo B, Zuck N. *Heart valve disease in Canada: Recommended components for a national strategy*. Edmonton (AB): Institute of Health Economics; 2022. Available from: <https://www.ihe.ca/advanced-search/heart-valve-disease-in-canada-recommended-components-for-a-national-strategy>.

<sup>3</sup> <https://www.ihe.ca/publications/heart-valve-disease-in-canada-recommended-components-for-a-national-strategy>

## Why is a System approach to HVD urgently needed?

Heart valve disease refers to a collection of disease conditions that affect the valves of the heart leading to progressive valvular dysfunction (narrowing of the valve or leakage or both), heart failure or death. HVD also includes deterioration of artificial valves (mechanical or bioprosthetic) used to treat native valve diseases. While HVD can affect individuals of all ages, its prevalence in Canada is highest in men and women above the age of 50 years. Therefore, HVD predominantly affects individuals who are major wage earners and in their prime of life, as well as seniors who due to disabling symptoms from HVD are no longer able to maintain their independence.

It is well appreciated that early diagnosis and early access to appropriate HVD focused care improves quality of life and survival. Currently, there are only two main therapeutic options for HVD: valve replacement or valve repair with cardiac surgery or transcatheter interventions. These of course are in addition to important role of medical management and prevention which needs to be optimized for patients with various valve lesions, both pre and post intervention. Additionally, medications available only provide symptomatic relief. Rapid advances in surgical and catheter techniques over the last two decades improve quality of life and survival in individuals receiving these therapies.<sup>4</sup>

Awareness of HVD and coordination of care for timely diagnosis and referral for intervention can be accelerated by coordination of care incorporating advances in cardiac techniques including echocardiography (cardiac ultrasound). However, both are lacking and highly variable across Canada and HVD recognized late or left untreated will have a large burden on society as a whole. Therefore, there is an urgent need to increase education and awareness, enable access to timely diagnosis, referral and intervention along with ongoing surveillance as fundamental principles to enable optimal outcomes of patients with HVD.

Many other areas of care have been developing and implementing more integrated approaches that manage the entire patient journey and support more seamless hand-offs to the benefit of the patient, and the system. Some of those are outlined in the supplementary material in the report. In particular there are treatment areas, which like HVD there are opportunities to plan interventions.

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<sup>4</sup> For example, calcific aortic stenosis (narrowing of the aortic valve) is one of the most prevalent forms of HVD, affecting approximately 1/12 Canadians above the age of 65 years. Studies demonstrate a 50% reduction in mortality over a 5 year period when valve replacement is performed with cardiac surgery or transcatheter techniques in patients with severe, symptomatic aortic stenosis.

Evidence reviews have linked integrated care implementation in many care areas to a range of outcomes including improvements in patient safety, physical and mental health status, quality of life and more effective provision of health services with reduced costs. This includes services which require planned interventions such as renal dialysis, breast cancer surgery and heart failure. There is now a concerted focus around the world on identifying the optimal components and configurations of both social and technical structures necessary implementing integrated care.

The Global Heart Hub has proposed that HVD is best managed in a network-based system across community, district hospitals and heart valve centers, involving multidisciplinary specialists and positioning the patient at the centre of organizational concerns.<sup>5,6</sup>

To support a more system level approach the central recommendation from this report is to move heart valve disease to a **Spoke-Hub-Node Model** of care. This would need to be tailored of course to the specific circumstances in each province and region but what is provided are some key considerations that should be included. This model is being effectively implemented in the area of heart failure with some great lessons from that work that can apply in heart valve disease.<sup>7</sup>

The spoke-hub-and-node (SHN) model represents an organization of care that allows collaborative work across the patient journey. Treatment and diagnostic services work collaboratively with the primary care sector and are highly integrated with community-based multidisciplinary teams of health care professionals and specialty care. The Spoke-Hub-Node model represents an integrated patient-centred care pathway whereby HVD patients transition seamlessly between different care settings.

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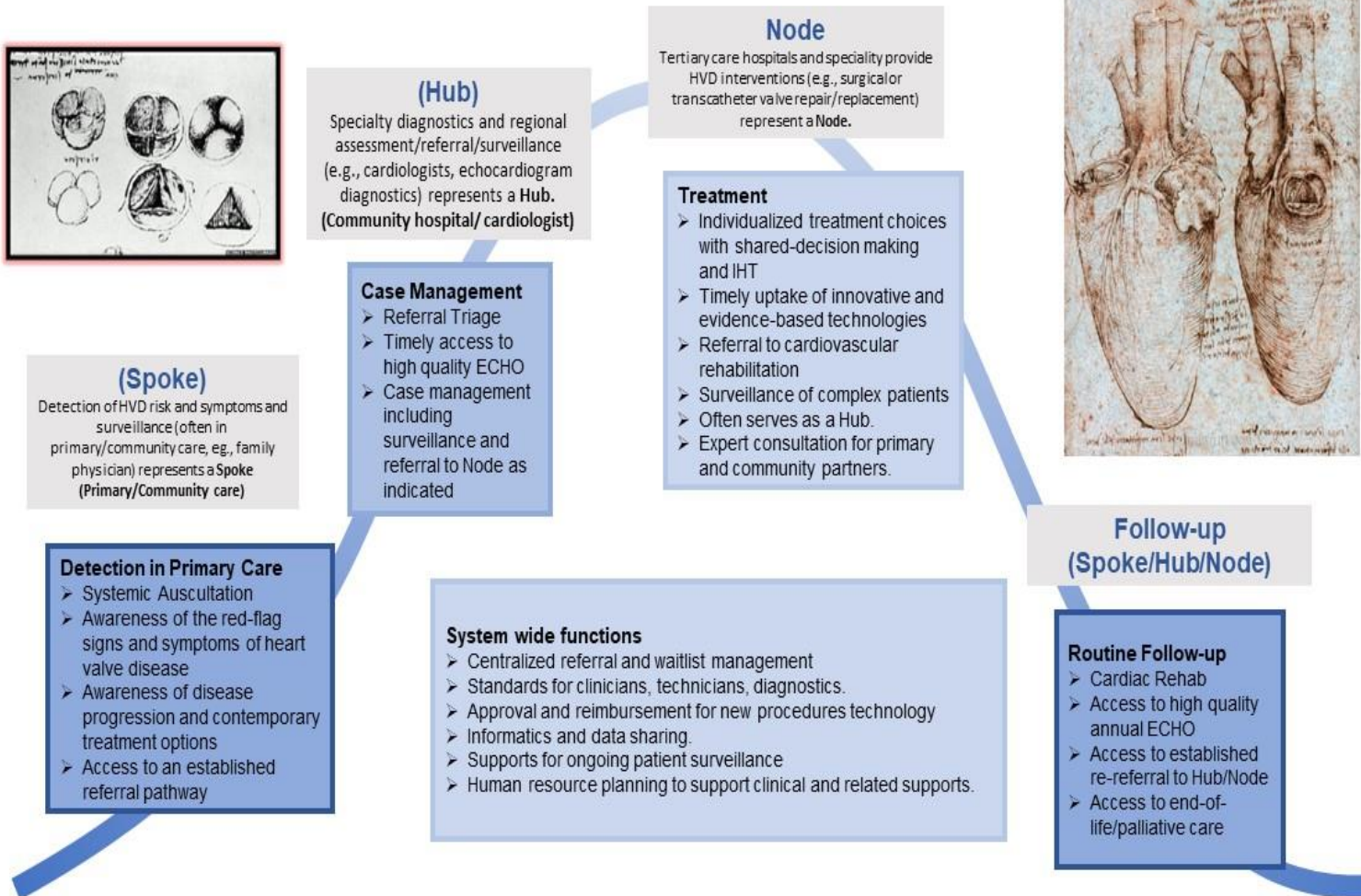
<sup>5</sup> Wait S, Krishnaswamy P, Borregaard B, Näumann J, Pearce K, Sitges M, et al. *Heart valve disease: Working together to create a better patient journey*. London: The Health Policy Partnership and the Global Heart Hub; 2020. Available from: [https://globalhearhub.org/wp-content/uploads/2021/11/HVD\\_report-final-2021.pdf](https://globalhearhub.org/wp-content/uploads/2021/11/HVD_report-final-2021.pdf).

<sup>6</sup> Nishimura RA, O'Gara PT, Bavaria JE, Brindis RG, Carroll JD, Kavinsky CJ, et al. 2019 AATS/ACC/ASE/SCAI/STS expert consensus systems of care document: A proposal to optimize care for patients with valvular heart disease: *Journal of the American College of Cardiology* 2019;73(20):2609-35.

<sup>7</sup> Integrated Heart Failure Care: Provincial Strategy and Implementation Roadmap - <https://www.corhealthontario.ca/ihfc>. Similar work underway in other provinces.

### Spoke – Hub – Node Model for Heart Valve Disease

CARE PATHWAY INTENSITY ↑



Adapted from CorHealth

Why is a Spoke-Hub-Node model optimal for management of HVD?

HVD therapies such as cardiac surgery or trans-catheter interventions need a minimal concentration of expertise and volumes for optimal outcomes and are best delivered at advanced cardiac centres. At present there are 33 such centres for HVD across Canada. While these centres are high volume and provide state of the art care on par with international standards, they will not be able to cope with a rapidly increasing volume of patients that require intervention. Rather than increasing the number of these centres, what is needed is an integrated system of care for early recognition, assessment, referral and continuing of the increasing number of patients with HVD.

Healthcare in Canada is provincially funded and regionally administered. Spoke and Hub models have been beneficial for optimal delivery and management in several areas of medicine (e.g. cancer, renal) as well as industry. More recently the Canadian Cardiovascular Society has also described a specific “Spoke-Hub-Node” model of care for management of Heart Failure. These heart failure models of care are currently being deployed across the Province of Ontario via Ontario Health Teams. A carefully designed and appropriately funded framework utilizing the Spoke-Hub-Model and specific for HVD patients can be built on existing infrastructure surrounding the existing 33 advanced cardiac centres. As volume and expertise expands, new centres may well be required but it will be important they meet national quality standards developed to support this new model.

A specific focus of the framework will be to clearly define and strengthen the “Hub”, which for HVD refers to speciality-based assessment and referral clinics to provide much greater system integration between Spokes (i.e. primary care) and the Nodes (i.e. advanced cardiac centres). Such a model would have clear expectations on health care delivery for HVD patients and can be tailored to regional resources and needs. For policy makers mapping HVD management to existing regional frameworks surrounding advanced cardiac centres enables system synergies in monitoring quality and costs of health care delivery. Additionally, over time it will facilitate strategic expansion of these networks with addition of advanced cardiac centres and provision of some advanced cardiac interventions at community centres in an integrated fashion.



## Section One: Recommendations

### Key recommendation

Heart Valve Disease services in Canada should be structured using the **spoke, hub node framework** as a guide for more effective, accessible and higher quality service to patients and families living with heart valve disease.

### Some Overall Goals for moving to spoke-hub-mode model:

- There is early identification of heart valve disease and diagnosis and patient-centred planning for heart valve disease patients should move more upstream and include prevention programs to reduce complications in at-risk populations)
- Admissions for interventions are planned and unnecessary ED visits and admissions are prevented.
- Key intervention decisions are configured around multidisciplinary team assessments. Increasingly teams should include geriatricians and other specialities depending on patient profiles.
- Shared decision-making should be a distinct step in the HVD care pathway, and inform all stages of policy where patients preferences, values and priorities are captured<sup>8</sup>.
- Post-intervention and outpatient surveillance is regularized and accountabilities are clear for who is responsible for that function and hand-offs are planned.
- Collaboration is easy and formal communication and process structures optimize the deployment, engagement, of professional resources to better support patients and families.
- Funding models and staffing are aligned to support coordination, multi-disciplinary teamwork and patient-centric pathways. They should also appropriate and integrated diagnostics at referral sites so patients can get comprehensive and coordinated assessments in a timely manner during single visits.
- Digital communication should allow for appropriate flow of information between Hubs and Nodes and involve electronic transfer of images, not simply reports.
- Funding models flexible to accommodate clinical judgement and patient choice.

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<sup>8</sup> Shared decision making (SDM) in heart valve disease is known to improve patient outcomes, however, too often this does not take place.

- There is a reduction in the high variation across the country in terms of equity of access to adoption of new technologies and improvements in patient-centred choice (This points to equity of access to new technologies which is biased by various factors that exist between regions and provinces).
- Programs are regularly and independently measured and reported on for their cost-effectiveness and improvements in key patient centred outcome indicators. This increases the confidence in ongoing investment and inform program design.<sup>9</sup>

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- <sup>9</sup> *Note:* Opportunities exist to build more formal evaluation through provincial procurement contracts to influence standardization and value for money.
  - *Some cautions:* Ensure to staff change management; Avoid unrealistic expectations of primary care providers; ensure to bring clinical communities along (build on success and/or failure of related clinical pathway reforms. failures); and recognize new team models require training and dedicated supports.

## Organizational Considerations

- Provincial coordination and quality structures are needed for these highly specialized services to ensure ongoing service site evolution and resourcing is based on demography and volume needs and not unplanned competition.
- Some concentration should continue around specialized centres but given ongoing technology advancement planning should include expansion of the role of ambulatory clinic capacities.
- There needs to be flexibility on structures depending on where the program is in Canada, building on existing infrastructure, patterns of service and relationships which exists with hospitals and free-standing clinics, including primary care clinics.
- Diagnostics and surveillance services should work to be more distributed and organized around where populations live.
- Role of nodes and hubs are not necessarily mutually exclusive: some nodes will do hub functions while some hubs will concentrate on diagnostic triage & follow-up accountability.
- Clear roles and responsibilities should be articulated for the spoke, hub and node including an enabling and accountable clinical governance model. An underdeveloped yet core function for heart valve disease system is systematic surveillance (including in primary/ambulatory care as well as peri-procedural pre and post procedure).
- Coordinated program for capacity development for assessing and responding to new technology development including establishing new nodes (e.g. converting hubs to nodes) and/or expanding certain activities/procedures to community centres based on evidence.
- Central components for improvement should include: *greater engagement with patients in detection phase* (events/education)/screening; *team-based assessment* – (that is condition and not procedure pathway informed); *centralized referral and waitlist management* (geography-based with clear accountabilities) as “air traffic control” and includes shared database to ensure patients get connected to the closest available site and then followed through particular journey, together with all their information; *clinical referrals should have mechanisms for performance reporting and tracking variation*; *triaging and decision* support are required for referral, follow-up and waitlist management.
- Diagnostic modalities are available and accessible such as wide availability of good quality 2D (fully accredited) echocardiography available to spoke, hubs and nodes and trans-esophageal echo (TEE) available including - expertise to hubs and nodes for both diagnostic and intra-procedural assessments.
- Consistent standards development for both cardiologist interpretation as well as diagnostic referral from primary care.

## Spoke

Detection of HVD risk and symptoms (often in primary/community care, eg. family physician) represents a **Spoke**.

- Primary care providers should have appropriate screening tools imbedded in EMRs to support their awareness and detection for HVD.
- Guidance needed for primary care for patient management while waiting for diagnostic or procedural intervention.
- Primary providers should have an identified referral centre and the ability to get timely and on-demand advice about management.
- Special consideration needs to be made to regional and in particular rural delivery which can include high turnover in primary care practice.
- Primary care provider/community specialist relationships require more purposeful development and engagement rather than expecting that to just happen.

## Hub

Specialty diagnostics and regional assessment/referral (e.g. cardiologists, echocardiogram diagnostics) represents a **Hub**.

- Hubs are clearly defined and identified as responsible for diagnostic triage and follow-up accountability. This might start with some form of voluntary certification.
- There will be different capacities depending on whether the hub is directly part of a node or not. Case and workload planning between tertiary nodes and community cardiac centres will need to address appropriate workflow and impact on providers.
- Certification/Recognition of Heart Valve Disease Hub should exist which recognizes node and non-node examples.
- There is a purposeful and transparent quality assurance program for HVD Hubs including targets and benchmarks for wait times for specialized cardiac diagnostics?
- Formal arrangements should exist related to reporting on imaging capacity and comparison to best practice to support HVD pathway. Below are some key issues.
  - Reliability around timeliness should exist through accountability arrangements between cardiac specialists and medical imaging.
  - Investment is required in robust quality assurance and certification for diagnostic testing, interpretation and for surveillance and management of patients through diagnostic support system. This should include some core competencies for staffing.
  - Reasonable and regularized pathway for access to advanced diagnostics (i.e. Cardiac CT) which could include publication of national access standards.
- Increasing role for Hub in ongoing surveillance post-intervention.

## Node

Tertiary care hospitals providing specialized HVD interventions (e.g. surgical or transcatheter valve repair/replacement) represent a **Node**.

- Treatment provided should be guided by multidisciplinary assessment accommodating patient priorities, preferences and values. Guidance for frail elderly incorporating consideration of current competing clinical perspectives should be undertaken along with strong links to palliative care.
- Nodes will also operate as Hubs in particular in follow up for complex patients. Expanded collaboration with community specialists and primary care should be expanded including co-location models.
- Funding models should be flexible to accommodate clinical judgement and patient priorities, preferences and values. They should also incorporate value propositions which look across the entire care pathway.<sup>10</sup>
- Formal Team based assessment with triage protocols should be consistently applied based on national guidelines which should be updated to address current gaps.
- Specialized diagnostics such as intra-procedural cardiac echo and cardiac CT should be accessible and have dedicated funding support.
- There should be dedicated core funding and models for active node mentorship to Hub and Spoke components.

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<sup>10</sup> Models could include mix of activity-based funding, bundled quality based procedures, and clinical alternative relationship plans. Lessons from past funding model implementations should be reviewed to mitigate issues of concern.

## System Level Supports

- Key supports will include enhanced primary care supports (funding and administration), strong system performance metrics, and engaged and informed provider and health system administrators.
- Human resources planning – training and integration of work-force to support patient journey including surveillance and multidisciplinary teams for diagnosis and treatment choices.
- Information technology and imaging sharing capabilities/capacities in terms of data, interoperability and communication links. There is a strong need for seamless communication, establishing protocols that are built into electronic medical records.
- Integrating strategy which will be key is centralized digital referral pathway adaptable to different authority structures. Referral processes will need to be based on defined criteria for triage.
- Regional level, Provincial and National forums for knowledge and experience sharing for spoke-hub-node implementation approaches and consistent application of guidelines-based care.
- National and Provincial evaluation strategy to a) examine and address equity in HVD and develop strategies to decrease differences for vulnerable patients e.g. urban vs rural, first nations, immigrants, b) examine differential access to uptake of new interventional procedures and techniques across the country. This variation should be measured, explained and minimized.

## Section 2: Background Material

### Heart Valve Disease Burden

Heart valve disease (HVD), also known as valvular heart disease, occurs when any of the four valves (aortic, mitral, tricuspid, and pulmonary) either cannot open properly to let blood flow through (stenosis) or cannot close properly to prevent backflow of the blood (regurgitation). HVD can cause stenosis, regurgitation, or combination of the two in any of the four valves. It can also affect more than one heart valve (i.e., multiple heart valve disease).<sup>11,12,13</sup> Patients with HVD, particularly mild or moderate aortic stenosis, are generally asymptomatic unless they have other comorbidities contributing to symptoms. Some patients will experience chest discomfort, pressure or tightness (angina), palpitations, arrhythmia, shortness of breath, fatigue or weakness, light-headedness, dizziness or near fainting, or swelling.

### Prevalence

As the population ages, HVD is emerging as an increasingly common health issue, though there continues to be insufficient data on the prevalence and incidence of HVD and likely under-detection/reporting of the disease.<sup>14</sup> The overall age-adjusted prevalence of moderate-severe HVD has been estimated at 2.5% (95% confidence interval 2.2–2.7%).<sup>15</sup> The prevalence is highly dependent and increases significantly with age, reaching 13% after age of 75.<sup>16,17</sup> It is estimated 1.5 million Canadians over the age of 65 will have HVD by 2040.

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<sup>11</sup> Heart and Stroke Foundation of Canada. Valvular heart disease [Internet]: Heart and Stroke Foundation of Canada; 2023 [cited 2023 Apr 20]. Available from: <https://www.heartandstroke.ca/heart-disease/conditions/valvular-heart-disease>

<sup>12</sup> Johns Hopkins Medicine. Heart valve diseases [Internet]: Johns Hopkins Medicine; 2023 [cited 2023 Apr 20]. Available from: <https://www.hopkinsmedicine.org/health/conditions-and-diseases/heart-valve-diseases>.

<sup>13</sup> National Heart Lung and Blood Institute (NIH). Heart valve disease [Internet]: NIH 2022 [cited 2023 Apr 20]. Available from: <https://www.nhlbi.nih.gov/health-topics/heart-valve-disease>.

<sup>14</sup> Messika-Zeitoun D, Baumgartner H, Burwash IG, Vahanian A, Bax J, Pibarot P, et al. Unmet needs in valvular heart disease. *European Heart Journal* 2023;ehad121.

<sup>15</sup> Nkomo V, Gardin J, Skelton T, Gottdiener J, Scott C, Enriquez-Sarano M. Burden of valvular heart diseases: A population-based study. *The Lancet* 2006;368(9540):1005-11.

<sup>16</sup> Lung B, Kappetein P. Introduction and general comments. In: *The ESC Textbook of Cardiovascular Medicine*, [Internet]. Oxford: Oxford University Press; 2018. 3rd ed., [cited 2023 Apr 20]. Available from: <https://doi.org/10.1093/med/9780198784906.003.0764>.

<sup>17</sup> Zamorano J, Lancellotti P, Pierard L, Pibarot P. *Heart valve disease state of the art*. Cham (CH): Springer Nature Switzerland 2020.

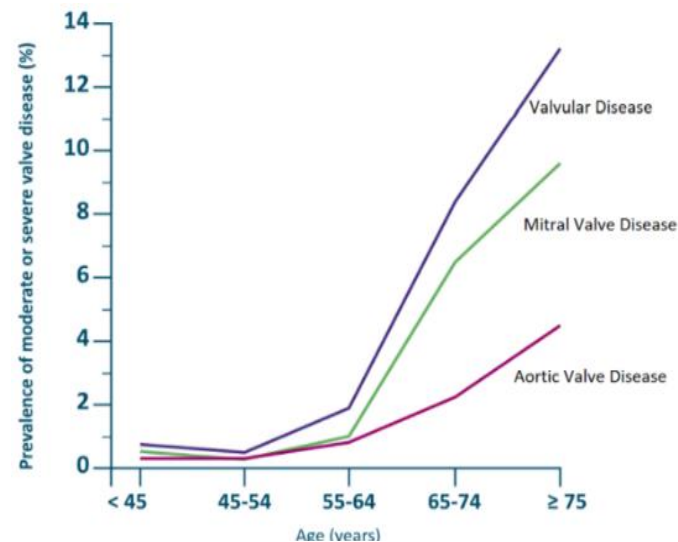


## Diagnosis and Treatment

HVD is treatable, but barriers exist in timely recognition, and access to interventions and ongoing care. Early detection remains a challenge due to a combination of low public awareness, missed detection opportunities (auscultation during routine primary care) and delays in diagnosis, which often results in late referral.<sup>18</sup>

Clinical practice guidelines now recommend more people undergo a valve-correcting procedures and to undergo them earlier.<sup>19,20</sup>

Transcatheter aortic valve replacement is now indicated where surgery had previously been the only procedural option. Post-treatment follow up is essential, including cardiac rehabilitation, psychological support, and ongoing monitoring to check for potential deterioration.<sup>21</sup> Specialist cardiac centers provided complex care to those with HVD across Canada, but access to these services varies geographically (a list of Canadian Cardiac Centres is available is [Appendix A](#)). A lack of and inequitable access to care can lead to undertreatment.



Source: Nkomo (2006); pooled data from several population-based studies.

<sup>18</sup> Global Coalition on Aging. *Heart valve disease: Harnessing innovation to save lives, mitigate costs, and advance the healthy aging agenda*. Galeway: Global Heart Hub; 2023. Available from: <https://globalhearhub.org/wp-content/uploads/2023/03/Position-Paper-on-HVD-and-the-Healthy-Aging-Agenda.pdf>.

<sup>19</sup> Otto CM, Nishimura RA, Bonow RO, Carabello BA, Erwin JP, 3rd, Gentile F, et al. 2020 ACC/AHA guideline for the management of patients with valvular heart disease. *Circulation* 2021;143(5):e35-e71.

<sup>20</sup> Vahanian A, Beyersdorf F, Praz F, Milojevic M, Baldus S, Bauersachs J, et al. 2021 ESC/EACTS guidelines for the management of valvular heart disease. *European Heart Journal* 2022;43(7):561-632.

<sup>21</sup> Marwick T, Gall S, Buscot M-J, Climie R, Phan H, Moodie M, et al. *Our hidden ageing: Time to listen to the heart*. Melbourne: Baker Heart and Diabetes Institute; 2017. Available from: [https://baker.edu.au/-/media/documents/impact/baker-institute\\_our-hidden-ageing-whitepaper.pdf](https://baker.edu.au/-/media/documents/impact/baker-institute_our-hidden-ageing-whitepaper.pdf).

## Health Outcomes

HVD can be a serious disease: left untreated, advanced valve disease can cause heart failure, stroke, arrhythmia, blood clots, or death including sudden cardiac arrest. The age-standardized aortic stenosis mortality rate is 3.6 per 100,000 people (95% CI 3.0–4.0) in North America and was estimated to be responsible for approximately 127,000 global deaths in 2019 and an associated loss of 1.8 million disability-adjusted life-years.<sup>22</sup> Within Canada, there has been a 68% increase in the number of hospitalizations for HVD between 2007 and 2017.<sup>23</sup>

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<sup>22</sup> Aluru JS, Barsouk A, Saginala K, Rawla P, Barsouk A. Valvular heart disease epidemiology. *Medical Science* 2022;10(2):32.

<sup>23</sup> Botly LCP, Lindsay MP, Mulvagh SL, Hill MD, Goia C, Martin-Rhee M, et al. Recent trends in hospitalizations for cardiovascular disease, stroke, and vascular cognitive impairment in Canada. *Canadian Journal of Cardiology* 2020;36(7):1081-90.

## Section Three: Emerging Models of Integrated Care

Integrated care is an approach to strengthen person-centered health systems through the promotion of comprehensive, multidisciplinary and coordinated delivery of services across the disease continuum.<sup>24</sup> It has also been framed as a “network of care,” in which a group of public and/or private health service delivery sites are deliberately interconnected through an administrative and clinical management model, to prioritize client-centered, effective, efficient operation and enables providers across all levels of care, including the community, to share responsibility for health outcomes.<sup>25</sup>

The pursuit of integrated care is a core strategy of healthcare reform, as a means to achieving the triple aim (that is, better population health, improved patient experiences and reduced cost), as well as health equity. Integrated care can be achieved by reorganizing existing systems at the macro, meso, and micro levels, using policies or regulations, new processes of care delivery and optimal products and technologies.

The National Institute for Health Research has outlined eight organizing principles to designing, implementing and evaluating integrated care:<sup>26</sup>

- Design: a shared vision and agreed objectives.
- Delivery: multidisciplinary teams.
- Management: governance arrangements and roles and responsibilities.
- People and communities: involving patients and families.
- Workforce: cross-professional and cross-organisational relationships.
- Leadership: organisational and leadership support.
- Technology and innovation: technology solutions as enablers.
- Information knowledge and learning: data for identifying needs and supporting development.



<sup>24</sup> Carter A, Mossialos EC, Pascal, Rappagliosi A. *Integrating care in health systems: The role of technology in transforming care pathways and achieving the triple aim*. London: The London School of Economics and Political Science 2022. Available from: <https://www.lse.ac.uk/business/consulting/assets/documents/Integrating-care-in-health-systems-Final-June-2022.pdf>.

<sup>25</sup> Carmone AE, Kalaris K, Leydon N, Sirivansanti N, Smith JM, Storey A, et al. Developing a common understanding of networks of care through a scoping study. *Health Systems & Reform* 2020;6(2):e1810921.

<sup>26</sup> National Health Service (NHS). *New models of care – what's the evidence? Summary findings*. London: NHS; 2018 Available from: <https://www.strategyunitwm.nhs.uk/sites/default/files/2019-03/New%20Models%20of%20Care%20-%20What%27s%20the%20evidence%20FINAL.pdf>.

Reviews have linked integrated care implementations to a range of outcomes including improvements in patient safety, health status, and more effective provision of health services with reduced costs.<sup>27,28</sup>

There is now a concerted focus on identifying the optimal components and configurations of both social and technical structures necessary implementing integrated care. While no one definitive model of care has been identified, those which have been proposed for HVD, as well as those used for other complex disease can serve as references for which ongoing developments with HVD integrated care could be imagined.

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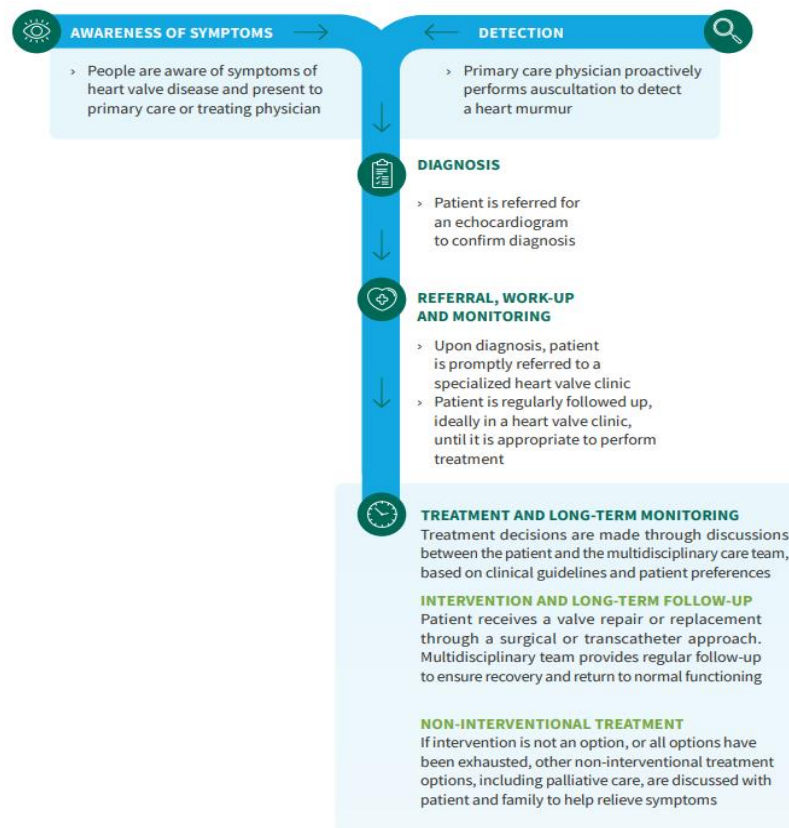
<sup>27</sup> Sarah D, Sarah F, Gill C. Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews. *BMJ Open* 2016;6(11):e011952.

<sup>28</sup> Rocks S, Berntson D, Gil-Salmerón A, Kadu M, Ehrenberg N, Stein V, et al. Cost and effects of integrated care: A systematic literature review and meta-analysis. *European Journal of Health Economics* 2020;21(8):1211-21

## Heart Valve Disease: Global and National Calls to Action for more integrated care

The Global Heart Hub commissioned a report on the “Calls to Action” that would optimize the HVD care pathway – from awareness to follow-up – from the patient’s perspective.<sup>29</sup> A Canadian version of the report was produced by Heart Valve Voice in February 2022: *Working Together to Create a Better Patient Journey*.<sup>30</sup>

It recommended that care be configured around multidisciplinary teams and centered in heart valve clinics, in order to enable different professionals to inform and advise discussions regarding treatment choices and provide comprehensive support adapted to each individual. There is also a strong urge to better utilize technologies to support earlier diagnosis and referral and to optimize treatment.<sup>31</sup> It has been proposed that HVD is best managed in a network-based system across community, district hospitals and heart valve centers, involving multidisciplinary specialists and positioning the patient at the centre of organizational concerns.<sup>32,33</sup>



<sup>29</sup> Wait S, Krishnaswamy P, Borregaard B, Nümann J, Pearce K, Sitges M, et al. *Heart valve disease: Working together to create a better patient journey*. London: The Health Policy Partnership and the Global Heart Hub; 2020. Available from: [https://globalhearhub.org/wp-content/uploads/2021/11/HVD\\_report-final-2021.pdf](https://globalhearhub.org/wp-content/uploads/2021/11/HVD_report-final-2021.pdf).

<sup>30</sup> Working Together to Create a Better Patient Journey - <https://tinyurl.com/ycyxhns> - <https://www.heartvalvevoice.ca/en/reports-resources>

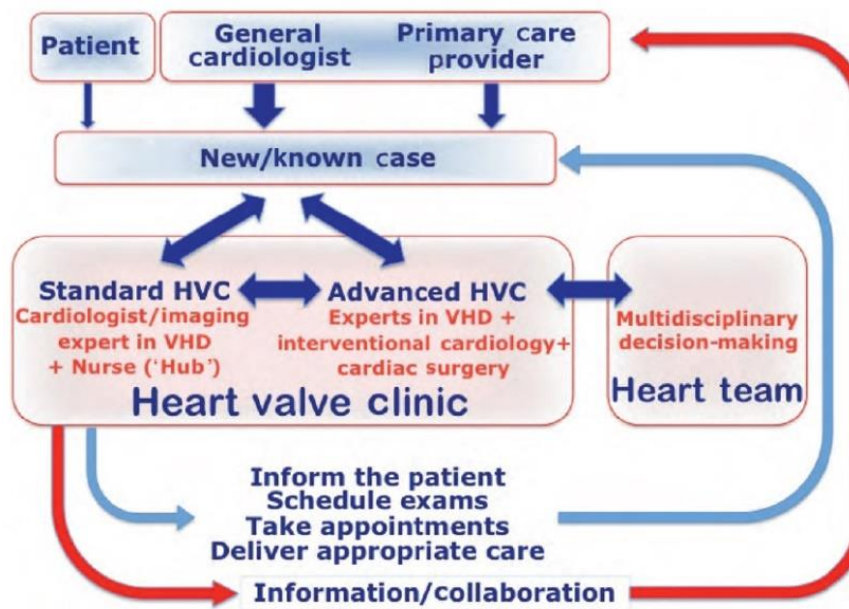
<sup>31</sup> Global Heart Hub, Global Coalition on Aging. *Heart valve disease: Harnessing innovation to save lives, mitigate costs, and advance the healthy aging agenda*. Galway: Global Heart Hub; 2023. Available from: <https://globalhearhub.org/wp-content/uploads/2023/03/Position-Paper-on-HVD-and-the-Healthy-Aging-Agenda.pdf>.

<sup>32</sup> Chambers J, Schlosshan D, Arden C, Campbell B, Dobson L, Fuat A, et al. *Network based care for heart valve disease* Swaffham: British Heart Valve Society 2020. Available from: [https://www.bhvs.org.uk/wp-content/uploads/2022/04/BHVS-Blueprint\\_2020.pdf](https://www.bhvs.org.uk/wp-content/uploads/2022/04/BHVS-Blueprint_2020.pdf).

<sup>33</sup> Nishimura RA, O’Gara PT, Bavaria JE, Brindis RG, Carroll JD, Kavinsky CJ, et al. 2019 AATS/ACC/ASE/SCAI/STS expert consensus systems of care document: A proposal to optimize care for patients with valvular heart disease: *Journal of the American College of Cardiology* 2019;73(20):2609-35.

Specialist HVD clinics (also known as HVD Centres or HVD Centres of Excellence, Advanced HVD clinics) have been at the forefront of developing comprehensive HVD care.<sup>34,35,36</sup> Specialist heart valve clinics would cover all aspects of valve disease management. These clinics would provide enhanced assessment with access to a full range of cardiac imaging modalities and other diagnostic services, manage moderate-severe HVD, determine the correct timing and modality of treatment, as well as conduct follow-up after invasive intervention.<sup>37</sup>

District general hospital (regional center) (standard) HVD clinics would function as a triage point, focusing on rapid assessment and surveillance of those with mild disease, utilizing health professionals with HVD competencies and community access to echocardiograms.<sup>38</sup> Community care would focus on early detection and may play a role in surveillance with the support of follow-up care, cardiac rehab, valve registries/recall and review systems<sup>39</sup>, clear processes for identifying the need for referral, and strong links to standard valve clinics. Efficient and high-quality communication should occur at every



Source: Lancellotti (2013)

<sup>34</sup> Messika-Zeitoun D, Baumgartner H, Burwash IG, Vahanian A, Bax J, Pibarot P, et al. Unmet needs in valvular heart disease. *European Heart Journal* 2023;ehad121.

<sup>35</sup> Chamber J, Lancellotti P. Heart valve clinics, centers, and networks. *Clinical Cardiology* 2020;38(1):65-74.

<sup>36</sup> Lancellotti P, Rosenhek R, Pibarot P, Iung B, Otto CM, Tornos P, et al. Esc working group on valvular heart disease position paper—heart valve clinics: Organization, structure, and experiences. *European Heart Journal* 2013;34(21):1597-606.

<sup>37</sup> Chambers JB, Prendergast B, Iung B, Rosenhek R, Zamorano JL, Piérard LA, et al. Standards defining a 'heart valve centre': ESC working group on valvular heart disease and European association for cardiothoracic surgery viewpoint. *European Heart Journal* 2017;38(28):2177-83.

<sup>38</sup> Bhattacharyya S, Parkin D, Pearce K. Educational series on the specialist valve clinic: What is a valve clinic? *Echo Research & Practice* 2019;6(4):T7-t13.

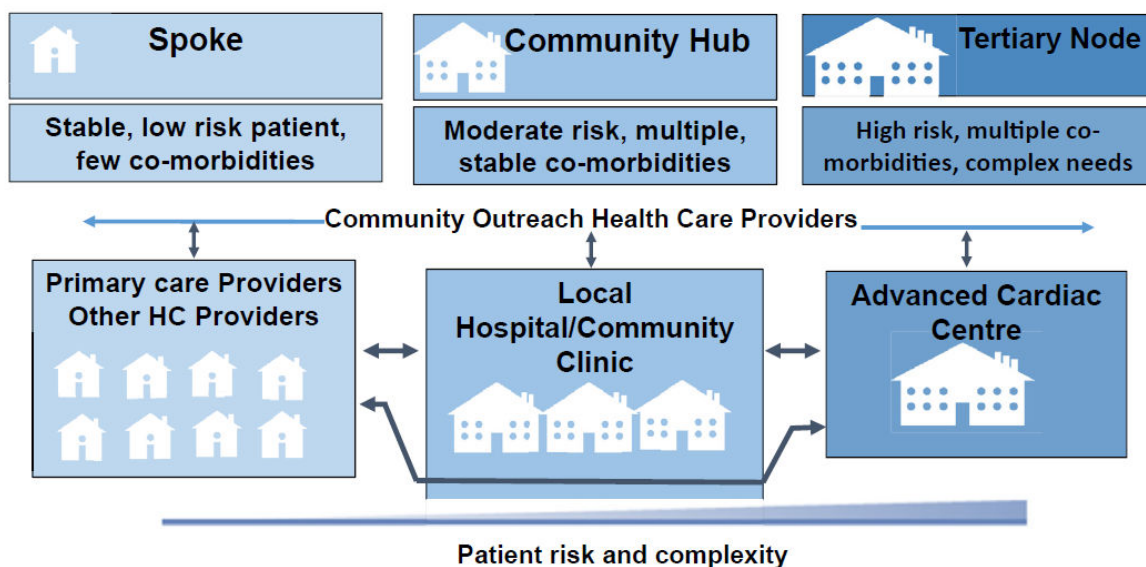
<sup>39</sup> The use of registries requires significant additional discussion.

level in the network of HVD care (and not only between standard HVD clinics and heart valve centres) to ensure all providers involved in patient care are aware of management decisions.

## Heart Failure: Example of emerging Spoke-Hub-Node Model

Heart failure's (HF) increasing prevalence, serious consequences, and high health system burden has preceded current HVD challenges and may provide a cardiovascular-specific template for system improvement. System reorganization for HF has centered around chronic care models that have been recommended for cardiovascular disease and are consistent with integrated care concepts.<sup>40</sup>

In Canada, a Spoke-Hub-Node model has been promoted as a system approach to care guided by patient risk and complexity, evidence-based management components, and health care professionals working collaboratively.<sup>41</sup> Spokes



reside within primary care, with the aim to accommodate the needs of the growing population through management of mild/moderate HVD patients. HF-trained primary care professionals start medications and can provide long-term surveillance/monitoring, with support and consultation from the Hub to optimize care. Intermediate-risk patients who require more complex care would be managed by a Hub – a community or hospital clinic led by multi-disciplinary team

<sup>40</sup> Wagner EH, Austin BT, Davis C, Hindmarsh M, Schaefer J, Bonomi A. Improving chronic illness care: Translating evidence into action. *Health Affairs* 2001;20(6):64-78.

<sup>41</sup> Huitema AA, Harkness K, Heckman GA, McKelvie RS. The spoke-hub-and-node model of integrated heart failure care. *Canadian Journal of Cardiology* 2018;34(7):863-70.

situated close to the patient's home. These clinics stabilize patients through review of available evidence-based therapies, optimize medications, and provide ongoing patient and caregiver education. Nodes, consisting of specialized-multidisciplinary programs run by HF physicians and on-site access to the full range of cardiac diagnostics and therapeutics. Nodes would stabilize and support high-risk or complex patients. Established within the system is a pre-arranged set of criteria for referral and risk stratification which guides the movement of patients through the continuum of services and is strengthened by established communications channels.

In Australia and the United Kingdom, clinical networks are utilized, with widely distributed specialty cardiology services providing a lead clinical role and care coordination.<sup>42,43</sup> Primary care's role is of identification and referral (thought may take a lead coordination role if appropriately supported by specialist clinicians) and complex care is provided at limited number of specialist centres. Multidisciplinary, coordinated care is central to their model of HF management, which considers the mechanisms for identifying and engaging the target population, ensuring continuity of care for patients who access services, agreed protocols and processes for transfer between health services, clearly described and agreed roles for all service provider, and effective shared data management.<sup>44</sup>

In the United States, a patient-centered comprehensive model for the care for congestive HF, the 360° HF centre, has been proposed.<sup>45</sup> This chronic care model is centered around the patient who is coupled with a care coordinator (a mid-level practitioner, familiar with the medical, mental, social and financial condition of the patient and direct point of contact for the patient and other providers) and supported by a team of multidisciplinary healthcare professionals (physical therapy, dietician, social worker, pharmacy, cardiology and primary care). These HF centres provide more extensive and interventional outpatient services than traditional cardiology clinics for managing low-risk patients, and are well networked with specialist HF services if high-risk features present.

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<sup>42</sup> State of Victoria: Department of Health and Human Services. *Design, service and infrastructure plan for Victoria's cardiac system*. Melbourne: Victorian Government; 2016 Available from: <https://www.health.vic.gov.au/health-system-design-planning/design-service-and-infrastructure-plan-for-victorias-cardiac-system>.

<sup>43</sup> National Institute for Health and Care Excellence (NICE). *Chronic heart failure in adults: Diagnosis and management*. London: NICE; 2018. Available from: <https://www.nice.org.uk/guidance/ng106>.

<sup>44</sup> National Heart Foundation of Australia. *Multidisciplinary care for people with chronic heart failure: Principles and recommendations for best practice*. Sydney: National Heart Foundation of Australia; 2010 Available from: [https://www.health.qld.gov.au/\\_\\_data/assets/pdf\\_file/0026/426365/hf\\_mdc\\_chf.pdf](https://www.health.qld.gov.au/__data/assets/pdf_file/0026/426365/hf_mdc_chf.pdf).

<sup>45</sup> Halatchev IG, McDonald JR, Wu WC. A patient-centred, comprehensive model for the care for heart failure: The 360° heart failure centre. *Open Heart* 2020;7(2).



## Breast Cancer: Integrated Care Pathways

Cancer care has been an early adopter of integrated care, with breast cancer (BC) care being the most frequent disease site for which this planning has occurred.<sup>46</sup> Generally, these plans have been designed with multidisciplinary teams at their core, with delivery of care spanning early assessment to post-treatment monitoring, and including components of patient and caregiver engagement, documentation and information exchange, and evaluation.

In Canada, Cancer Care Ontario has developed guidance on integrated care planning.<sup>47</sup> It recommends that an Integrated Care Plan incorporates elements of clinical guidelines, treatment plans, disease pathways, and personalized care plans. Organization around the plan integrates eight steps, configured into 4 phases:



Source: Arthurs (2017)

- Identify: suspicion of cancer; and making a comprehensive referral.
- Assess: confirm diagnosis and eligibility for integrated care planning, and patient assess needs and goals.
- Plan: identify the members of the core inter-professional care team and ensure that both health care professionals and the patient/caregiver understand and has access to the care plan and resources.
- Manage: monitor for progression towards the desired outcomes, and review and revise the plan as needed.

<sup>46</sup> Khan AI, Arthurs E, Gradin S, MacKinnon M, Sussman J, Kukreti V. Integrated care planning for cancer patients: A scoping review. *International Journal of Integrated Care* 2017;17(6):5.

<sup>47</sup> Arthurs E, Evans M, Khan AI, Kukreti V, Gardin S, MacKinnon M. *Integrated care planning – an evidence-informed approach to designing and delivering coordinated, continuous & person-centred care for cancer patients*. Toronto: Cancer Care Ontario; 2017. Available from: <https://www.cancercareontario.ca/en/guidelines-advice/types-of-cancer/43321>.

For BC, pathway maps have been developed for prevention, screening and diagnosis, treatment and follow-up in Ontario.<sup>48</sup> Organization of integrated BC care has focused on roles and responsibilities, rather than location of services. The Ontario Breast Screening Program provides high quality breast cancer screening, oncologists and surgeons support diagnosis and treatment decisions, and psychosocial and palliative care specialists provide care through monitoring and follow-up. Ongoing care with and awareness by primary care providers is assumed to be part of the pathway map.

The Cancer Council in Australia has developed an “optimal care pathway,” which describes the integrated model of BC care, and includes seven underpinning principals: patient-centered care, safe and quality care, multidisciplinary care, supportive care, care coordination, communication, and research and clinical trials.<sup>49</sup> Care coordination crosses the acute and primary care interface, often with support from a dedicated coordinator and electronic medical records, to achieve consistency of care through clear communication, linkages and collaborative integrated care planning. This pathway uses a lead provider model: one clinician responsible for overseeing patient care within the multidisciplinary setting and leads communication across the team.

In Europe, a specialist breast unit/centre has been outlined as a place where BC is diagnosed, treated, and provides all the services ideally within the same facility, including genetics, supportive and palliative care and psychosocial support.<sup>50</sup> These centres use clinical guidance to develop patient pathways.

In the United States, 4R models (Right information and Right care for the Right patient at the Right time) are being explored in care pathways for BC, and for optimizing teamwork and care delivery starting at diagnosis.<sup>51,52</sup> This model is utilizes principles from business/project management and as such, manages a BC patient using having a physician and nurse team develop a care project plan (“care sequence”), which specifies timing and sequencing of interdependent care events across clinical domains relevant to the patient’s care.

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<sup>48</sup> Cancer Care Ontario (CCO). Breast cancer pathway map [Internet]: CCO; 2017 [cited 2023 May 10]. Available from: <https://www.cancercareontario.ca/en/pathway-maps/breast-cancer>.

<sup>49</sup> Cancer Council and Department of Health Victoria. *Optimal care pathway for people with breast cancer (second edition)*. Melbourne: Cancer Council Victoria; 2020. Available from: [https://www.cancer.org.au/assets/pdf/breast-cancer-2nd-edition#\\_ga=2.200003566.1107227345.1683747580-660455969.1683654045](https://www.cancer.org.au/assets/pdf/breast-cancer-2nd-edition#_ga=2.200003566.1107227345.1683747580-660455969.1683654045).

<sup>50</sup> Biganzoli L, Cardoso F, Beishon M, Cameron D, Cataliotti L, Coles CE, et al. The requirements of a specialist breast centre. *The Breast* 2020;51:65-84.

<sup>51</sup> Weldon CB, Friedewald SM, Kulkarni SA, Simon MA, Carlos RC, Strauss JB, et al. Radiology as the point of cancer patient and care team engagement: Applying the 4r model at a patient's breast cancer care initiation. *Journal of the American College of Radiology* 2016;13(12 Pt B):1579-89.

<sup>52</sup> Trosman JR, Weldon CB, Rapkin BD, Benson AB, Makower DF, Liang S-Y, et al. Evaluation of the novel 4r oncology care planning model in breast cancer: Impact on patient self-management and care delivery in safety-net and non-safety-net centers. *JCO Oncology Practice* 2021;17(8):e1202-e14.

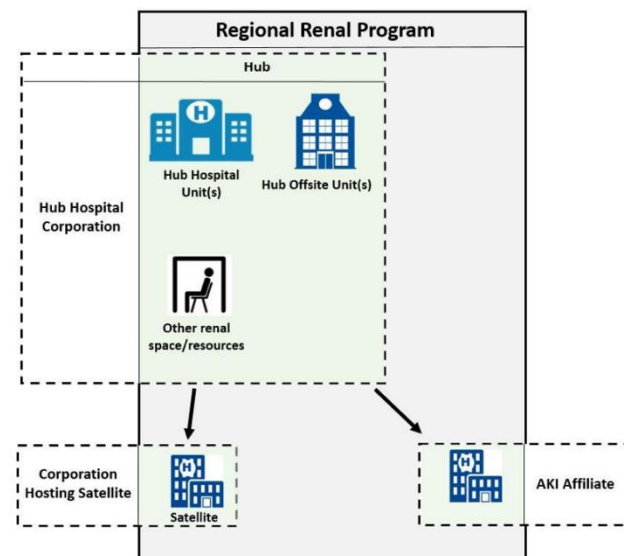
## Chronic Kidney Disease: Shared Care and Regional Network Models

Chronic kidney disease (CKD) management presents similar challenges to HVD, in that there is low awareness in both patients and clinicians, is generally asymptomatic, and has variable and complex treatment strategies.

In Canada, shared-care models (multidisciplinary, team-based programs) are recommended for chronic kidney disease, and are predicated on the idea that the combination of skills offered to patients will improve outcomes for both patients and the system.<sup>53,54</sup> Primary care focuses on screening populations, initiating assessment, and begin/intensify routine therapies which affect kidney disease outcomes. Kidney Care Clinics, run by nephrologists, provided assessment, education and provide therapeutic recommendations and facilitate transitions to the patient’s preferred modality.<sup>55</sup> The primary care-nephrologist interface is supported by good communication and trust in each other’s expertise.

Specifically, Ontario’s Renal Network has developed a Regional Model of Care for CKD, which has three branches of service:<sup>56</sup>

- Hubs: located at either an academic or community hospital and provide a full spectrum of renal services; each hub supports the satellites and affiliates within its program.



Source: Ontario Renal Network (2018)

<sup>53</sup> Levin A, Steven S, Selina A, Flora A, Sarah G, Braden M. Canadian chronic kidney disease clinics: A national survey of structure, function and models of care. *Canadian Journal of Kidney Health and Disease* 2014;1(1):29.

<sup>54</sup> Poulos RK, Antonsen JE. Optimizing chronic kidney disease care: The primary-specialty care interface. *British Columbia Medical Journal* 2005;47(6):300-4.

<sup>55</sup> BC Kidney Care Committee. *Best practices: Kidney care clinics*. Vancouver BC Renal 2019. Available from: [http://www.bcrenal.ca/resource-gallery/Documents/Best\\_Practices-Kidney\\_Care\\_Clinics.pdf](http://www.bcrenal.ca/resource-gallery/Documents/Best_Practices-Kidney_Care_Clinics.pdf).

<sup>56</sup> Ontario Renal Network. *Regional renal models of care (version 3)*. Toronto: Ontario Renal Network; 2018 Available from: <https://www.ontariorenalnetwork.ca/sites/renalnetwork/files/assets/regionalrenalmodelsofcare.pdf>.

- Satellites: located within a hospital or other healthcare organization and provide routine renal services for people who are medically stable and outpatient dialysis. Satellites may also provide more complex renal services (e.g., acute dialysis) to more medically complex patients, where approved by and with oversight from the hub.
- Acute kidney injury affiliates: hospitals within the Regional Renal Program that provide acute dialysis to people with acute kidney injury, but do not provide an outpatient dialysis unit or other routine renal services.

Each program has a Director and Medical Lead, situated in the Hub hospital corporation, and is responsible for defining core responsibilities/deliverables and providing oversight across all services to ensure standards of care requirements are being met. Quality-based procedure funding for direct costs (both bundled and unbundled) is provided to the hubs and distributed to the satellites and affiliates, with additional funding available through quality improvement initiatives.

In Australia, standardized best practice pathways (Optimal Care pathways for CKD) are being rolled out, which is looking to improve resource and service planning to deliver coordinated care closer to the patient's home.<sup>57</sup> In the United States, Centres for Medicare and Medicaid Services are developing comprehensive care models, built on Accountable Care Organizations, to coordinate care across primary care providers, nephrologists and dialysis clinics, with value-based performance measures tied funding to incentive coordination and multi-disciplinary teamwork.<sup>58,59</sup>

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<sup>57</sup> Kidney Health Australia. *The national strategic action plan for kidney disease*. Melbourne: Government of Australia Department of Health; 2020. Available from: <https://kidney.org.au/get-involved/advocacy/national-strategic-action-plan-for-kidney-disease>.

<sup>58</sup> Johnson DS, Meyer KB. Integrated care for people with kidney disease: The perspective of a nonprofit dialysis provider. *Clinical Journal of the American Society of Nephrology* 2019;14(3): 448-50.

<sup>59</sup> Tummalapalli SL, Mendu ML. Value-based care and kidney disease: Emergence and future opportunities. *Advances in Chronic Kidney Disease* 2022;29(1):30-9.

## Quotes from discussants

*“We need purposeful shared care development. If you're going to develop teams, you can't just flip a switch and put a bit of extra money in and hope by serendipity it will happen.”*

*“As a specialist, I don't have to do as many follow-ups as I used to because the team does it and so if the team is well supported you end up having a shift in the distribution of work towards a more appropriate provider, be it a nurse practitioner or a nurse or pharmacist.”*

*“Key supports will include enhanced primary care supports, strong system performance metrics, and engaged and informed provider and health system administrators. “*

*Nodes will also act as Hubs in many cases but we need to distribute diagnostic and surveillance more closely where people live while focusing special centers for interventions.*

*“Family docs don't want education on how to better manage their patients. They are looking for diagnostic information and consistent feedback and regular consults on perhaps unexplained ECHO or whatever that might be suspicious that require advancement, that information is what's important”*

*“We need to make collaboration easy and avoid “not my responsibility” responses along the patient journey.”- Cardiologist*

*“Not everyone needs to see a heart team. Ongoing issue is patients are seen too early – and sometimes too late. ” - Cardiologist*

*“Community cardiac surgical center can increasingly do more complex procedure. The tertiary hospital node is not the only ‘game in town’”.*