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The Home Hemodialysis Hub: Physical Infrastructure and Integrated Governance Structure

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Implementing Hemodialysis in the Home
A Global Perspective

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International Society for Hemodialysis

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Abstract

An effective home hemodialysis program critically depends on adequate hub facilities and support functions and on transparent and accountable organizational processes. The likelihood of optimal service delivery and patient care will be enhanced by fit-for-purpose facilities and implementation of a well-considered governance structure. In this module, we describe the required accommodation and infrastructure for a home hemodialysis program and a generic organizational structure that will support both patient-facing clinical activities and business processes.

Introduction

A well-functioning home hemodialysis (HD) training facility is critical for the success of a program. These facilities often have wider functions than just those of home HD training, however, and need to be resourced appropriately. Most support the entire patient journey from inception into the program to eventual exit, as illustrated in Figure 1.[1] It is important to realize that this journey extends to prospective patients who are not yet receiving home HD, who should be presented with the opportunity to tour training facilities, meet home HD patients, and get to know the staff and program. For this reason, the term "home HD hub"is preferable to "home HD training facility," and better reflects its broader functionality. The hub should, therefore, have appropriate physical infrastructure and organizational structure to support optimal clinical governance and effective operations management. Inadequate facilities and support functions will inevitably lead to patients experiencing problems and delays, and having poorer outcomes and overall experiences.

In this module, we describe the required accommodation and infrastructure for a home HD program, and provide a generic organizational structure that will support both patient-facing clinical activities and business processes. However, a defining feature of successful home HD programs is the adaptability and cross-functional skill sets of staff. It is not unusual or inappropriate for 1 person to have several roles that cross the clinical-business divide; for instance, home HD clinical staff often have business functions (eg, organizing equipment, managing supply inventory, and performing troubleshooting activities), and managers are often heavily involved with clinical governance implementation (eg, patient safety programs). This is not a shortcoming, so long as everyone has clear roles and responsibilities within the program—roles should have defined accountability and performance measures (the "what"), accepting that people may fill several different roles, especially in smaller programs (the "who"). When all parties understand and accept "who" does "what," the program and the care it delivers should not be compromised.

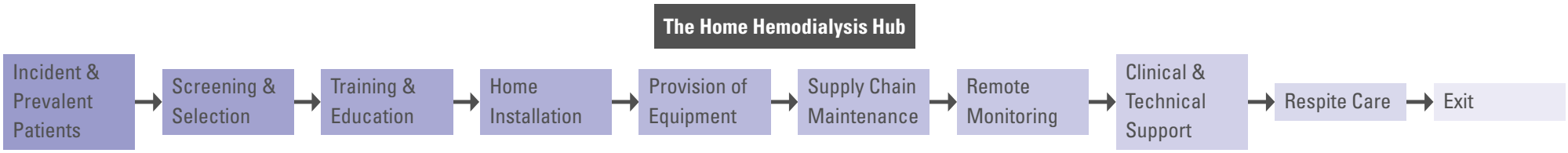

Figure 1. The home hemodialysis resource map. Adapted from Alhomayeed B, Lindsay RM. Saudi J Kidney Dis Transpl. 2009; 20:185–191.[1]

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The size and complexity of the home HD hub will depend on the number of patients in the program and whether it aims to grow. In Japan, most home HD programs are small and located within hospital HD facilities,[2] while in Australia and New Zealand, home HD programs are larger and, in most cases, enabled by specialized facilities and personnel (Figure 2).[3] In general, a program can be started and managed with modest infrastructure and simple operating mechanisms (ie, existing hospital infrastructure and personnel). When the program expands beyond 10 to 20 patients, more substantial, specialized physical and human resources are required.

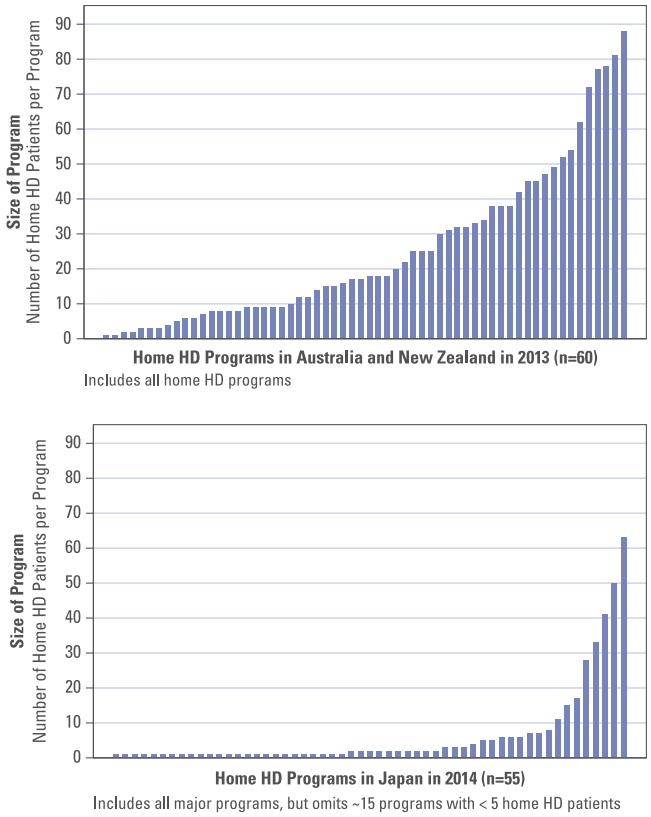

Figure 2. Size of Home HD Programs in Australia and New Zealand and Japan.[2,3]

Infrastructure

There a several key characteristics to consider for a home HD hub: its location, the number and type of training stations, and its physical and functional configuration.

Facility Location

The location of the home HD hub should be carefully considered to optimize accessibility for patients. Accessibility is defined not only by traveling distances but also by available options for patient parking and proximity to local transport. Ideally, the location for the home HD hub should have the potential for infrastructure expansion, should there be future growth of the program.

Home HD training is a core function of the hub—it can occur in a variety of settings, and there are no clear data that support the superiority of 1 setting over another. There are 4 main options for the location of home HD training, some of which are designed to allow functional integration of the hub with other dialysis services: (i) adjacent to or within hospital dialysis facilities, (ii) adjacent to or within community-based satellite dialysis facilities, (iii) a stand-alone facility, and (iv) the patient's home.[4–6] In our opinion, most locations are acceptable, although the advantages and disadvantages of each setting should be noted. A comparison of the various options for the location of the home HD hub is provided in Table 1.[6] Although less common than in-center training, the option of performing home HD training in the

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Table 1. Comparison of Locations for Home HD Hub or Training

Considerations		Hospital	Satellite Site	Stand-Alone Site	Home
Clinical Considerations	Nephrologist on site	✓✓✓	✓✓	✓✓	–
	Allied health on site	✓✓✓	✓✓	✓✓	✓
	Laboratory on site	✓✓✓	–	–	–
	Access to specialist nurses (eg, vascular access, transplant nurses)	✓✓✓	✓✓	✓✓	✓
	Access to electronic medical records	✓✓✓	✓✓✓	✓✓	✓
	Visibility and promotion of home HD training to facility HD patients	✓✓✓	✓✓	–	–
	Staff access to facility HD patients for cultivation or assessment for home HD	✓✓✓	✓✓✓	–	–
	Options to commence preemptive home HD training	✓	✓	✓	✓✓✓
	Options for respite care of home HD patients	✓✓✓	✓✓✓	–	–
Patient-Centered Considerations	Promotion of a culture of self-management	✓	✓✓	✓✓	✓✓✓
	Flexibility of training times	✓✓	✓✓	✓✓	✓✓✓
	Proximity to home	✓	✓✓	✓✓	✓✓✓
	Safety and security	✓✓✓	✓✓	✓✓	✓✓✓
	Homelike environment	✓	✓	✓✓	✓✓✓
	Options for patient peer support	✓✓✓	✓✓✓	✓✓✓	✓
Optional Considerations	Potential for shared staff and logistic infrastructure	✓✓✓	✓✓✓	–	–

✓✓✓ = Usually; ✓✓ = Sometimes; ✓= Seldom; – = Usually Not.

HD = hemodialysis.

Adapted from Fortnum et al. Kidney Health Australia: A model for home dialysis, Australia, 2012.[6]

patient's home is an interesting one and should not be discounted. Training in the home removes options for cross-cover between trainers during training sessions and increases inefficiencies and duplication for shared tasks (eg, data management and stock management). Home training may be a financially feasible option for smaller or new programs—overall program costs are reduced by avoiding the need for a home HD infrastructure; however, these cost savings may be offset by the expense of unnecessary home installations for patients who fail training.

Number of Home HD Training Stations to Support the Program

The required number of HD stations for the hub depends on several factors: (i) number of home HD patients who train each year, (ii) duration of training, (iii) number of days per week and hours per day during which the training facility operates, and (iv) whether the hub provides respite or "fallback" support for patients.

There is marked variation in service delivery among programs, although some general guidance can be provided:

- For new programs, it is typical to have modest training objectives for the first year, such as targeting only 5 to 10 patients. In contrast, larger programs may target up to 20 to 30 patients per year to maintain a census of approximately 100 trained home HD patients.
- In general, it is hard to predict the average duration of training for a cohort of patients, especially given individual patient variability and differing models of care. There is little evidence published on this topic, and what has been published requires careful interpretation before findings are extrapolated to different settings. The duration of training will vary according to patient-related factors, such as literacy, health literacy, general health, and level of functioning; service-related factors, including effectiveness of training, experience and confidence of trainers, and the clinical culture around patient safety and risk aversion; the ease of use and intuitiveness of the dialysis machinery; and whether patients have to learn to needle their fistula or graft, and how easy it is for them to do so.[7,8] In published reports and cumulative clinical experience, the number of sessions needed to complete training requirements is 20 to 40 sessions, but occasionally more may be needed (see the "Patient Selection and Training for Home Hemodialysis" module).[8–15] In the anecdotal experience of the authors, the duration of training tends to be consistent across countries: those with a lower prevalence of home HD, such as the United States, report a lower number of home HD training sessions (< 30) than countries with a higher prevalence of home HD patients, such as New Zealand (> 30). It is possible that this relates to the higher degree of patient selection in the United States (ie, only the most capable and motivated patients undergo home HD) and the reduced availability of "ideal patients" in New Zealand, where training needs to accommodate a more educationally and medically diverse home HD patient population.
- Respite or "fallback" support is provided for patients in the event of illness, technical problems, or home/social circumstances that require temporary support in a dependent-care HD facility.[16] Often, home HD training facilities rather than hospital or satellite facilities will manage respite support. In this way, a culture of self-management and consistency of patient care is maintained through the home-oriented training staff, with an explicit expectation of an eventual return to home HD as the long-term treatment modality. Where respite support is managed by the training facility, approximately 1 to 2 respite stations will be needed for every 3 to 4 training stations, depending on the size and comorbid burden of the home HD census.

A guide for determining the required number of training stations in a hub is provided in Table 2. Based on the estimated number of patients that the program plans to train and the approximate length of their training, the table indicates the required number of HD training stations (not including respite or fallback support) as a function of the operating days and hours of the training facility.

Of note, local reimbursement regulations may dictate a scale of economy such that an HD training facility needs to have a certain throughput to be viable. For instance, in the United States, it has been widely recommended that a successful unit should train at least 1 patient per month, with a goal of maintaining a census of 20 active patients.[17–19] Although no calculation is readily available to support these numbers, it is

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Table 2. Minimum Number of Home HD Training Stations Required for a Hub[a]

Training 3 Days per Week, 50 Weeks per Year					Training 5 Days per Week, 50 Weeks per Year				
A	B	C			A	B	C		
Home HD Patients Trained per Year	Home HD Training Shifts per Day[b]	Sessions Needed to Complete Training			Home HD Patients Trained per Year	Home HD Training Shifts per Day[a]	Sessions Needed to Complete Training		
		20 Sessions	40 Sessions	60 Sessions			20 Sessions	40 Sessions	60 Sessions
		Home HD Training Stations Needed (n)[c]					Home HD Training Stations Needed (n)[d]		
5	1	1	2	2	5	1	1	1	2
	2	1	1	1		2	1	1	1
15	1	2	4	6	15	1	2	3	4
	2	1	2	3		2	1	2	2
25	1	4	7	10	25	1	2	4	6
	2	2	3	5		2	1	2	3

HD = hemodialysis.

[a]Does not account for respite or "fallback" support.

[b]Either morning only (1) or morning and evening (2).

[c]Calculated as (A x C) / (3 x 50 x B). This number is rounded up, taking the ceiling value (the integer n such that [n-1] < [home HD training stations] < n).

[d]Calculated as (A x C) / (5 x 5 B). This number is rounded up, taking the ceiling value (the integer n such that [n-1] < [home HD training stations] < n).

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a consistent recommendation from opinion leaders from that country. Therefore, it is important to be aware of local factors that may dictate facility size in any given country and/or region.

Physical Requirements

General Principles

First and foremost, the hub should be fit for purpose. In smaller institutions, home HD and peritoneal dialysis programs may be colocated to provide functional integration of the 2 programs. This integration can allow for sharing of any or all of the following services: physical infrastructure (eg, training and clinical rooms), human resources (eg, cross-functional nursing and clinical dialysis technicians), and clinical services (shared clinics and drop-in services). If this is the case, then the physical setting should be suitable for both programs. Integrated home dialysis programs have been used in some programs to facilitate patients' awareness of both home dialysis modalities, and enable easier discussions of planned modality transitions that allow patients to remain independent.[20] At some institutions, however, there are sufficient numbers of patients for each program to exist separately, and a hub can be designed and orientated to purely home HD.

Whether colocated or stand-alone, there is no substitute for purposeful home HD infrastructure. The opportunistic location of home HD facilities in an unused space or corner of a hospital dialysis unit (colloquially known as the "one-room afterthought") will impede recruitment, training, and the growth of the program. The workspace should meet the needs of patients and their care partners in creating an optimal learning environment that is safe, private, and free of distractions. The workspace should also meet the needs of staff and minimize the time they spend handling logistics.

Ideally, the physical structure should showcase the program, as exemplified in Figure 3, and clearly establish that home HD is a priority and focus of the organization. A highly visible home HD hub will promote the program to both referring clinicians and patients.

The generic components of a home HD hub are listed in Table 3, with key components discussed in the following subsections.

Patient Areas

Home HD training stations will generally have minimum sizes that are specified by local legislation, but should be large enough (eg, 5 × 4 m) to accommodate the dialysis equipment (machine, blood pressure machine, side table, and disposal facilities) as well as a guest chair and training aids. In general, home HD training stations have a "solo" arrangement, with a single HD station per room. Some programs, however, have very effective stations with open plans, similar to what might be found in a hospital HD facility. The advantages and disadvantages of solo and open-plan training are presented in Table 4. Whatever the

Figure 3. Showcasing your home hemodialysis hub: the Northwest Kidney Centers Home Dialysis Hub in Seattle (courtesy of Aaron Herold).

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Table 3. Components of a Home HD Hub

Patient areas • Home HD training stations (options for solo and open-plan training are ideal) • Clinic rooms • Procedure room • Patient toilets with wheelchair access • Patient kitchenette/lounge areas	Soiled utility room
	Storage • Spare machines, wheelchairs, and equipment • Bulk storage for large deliveries • Clean supply (eg, solutions, disposables) • Secure chemical storage • Secure external storage for biohazard and recyclable waste
Staff areas • Office space for administrators, nurses, nephrologists • Meeting room • Staff toilets, showers, lockers • Staff kitchenette or common break areas	Vehicle Parking
	Home HD Machine Workshop
	Remote Monitoring Facilities
Reception area • Drop-off zone • Greeter desk • Seating area • Education and communication surfaces	
Clinical workstations for nurses and clinical dialysis technicians	
Clean utility and medication room(s)	

HD = hemodialysis.

configuration, training spaces should be able to accommodate educational resources, such as DVD players, television monitors, whiteboards, written materials, and a computer (ideally wall mounted) or mobile wireless computer workstation (Figure 4).

Clinic rooms can be generic. A separate and specifically designated procedure room is sometimes desirable for home HD hubs that are not colocated with a hospital. This room can be equipped for minor procedures, such as tunneled central venous catheter removals and wound dressings, or for even more major procedures, such as central venous or peritoneal dialysis catheter insertions (if the home HD and peritoneal dialysis programs are integrated and colocated).

Figure 4. The Northwest Kidney Centers Home Dialysis Hub in Seattle: A home dialysis training station (courtesy of Aaron Herold).

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Table 4. Solo vs Open-Plan Configurations for HD Training Stations

Solo Configuration	Open-Plan Configuration
Minimizes risk of cross-infection	Potential for increased risk of cross-infection
Potential for lack of monitoring during training	Easy monitoring during traning
Potential social isolation	Socialization
Private	Potential lack of privacy
Quiet and conducive for learning	Potentially noisy and distracting
Only option is solitary training	Option for shared learning and group teaching
Isolated training experience	Peer support during training
Mimics the home HD treatment environment	

HD = hemodialysis.

There are other special characteristics to consider, including the following:

- Safety systems should meet national and state licensing and regulatory requirements. Hubs should also be designed to include a resuscitation trolley ("crash cart") bay, and clearly marked and adequate thoroughfares for emergency ambulance access. Lighting, electrical systems, and plumbing should also meet national and state licensing and regulatory requirements.
- Large glass sections should be used where appropriate to allow for monitoring (Figure 5).

Figure 5. The Northwest Kidney Centers Home Dialysis Hub in Seattle: Large glass sections allow for patient monitoring during training (courtesy of Aaron Herold).

- Rooms should include a counter with a sink, hand washing facilities, and a mirror (Figure 6).
- Patients should be kept comfortable through the use of appropriate furniture and climate controls.
- Home HD training spaces should be able to accommodate training for nocturnal dialysis, including flexible lighting, comfortable trundle beds, noise control, and blinds to allow privacy.

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Figure 6. The Northwest Kidney Centers Home Dialysis Hub in Seattle: Rooms should include a counter with a sink, a faucet, and a mirror (courtesy of Aaron Herold).

Figure 7. The Northwest Kidney Centers Home Dialysis Hub in Seattle: The reception area (courtesy of Aaron Herold).

Figure 8. The Northwest Kidney Centers Home Dialysis Hub in Seattle: The greeter desk (courtesy of Aaron Herold).

Staff Areas

Office space can be generic but should accommodate necessary staff and provisions for their required job functions. In most cases, separate offices are required for the nephrologist, manager, and charge nurse, with workstations for nurses and clinical dialysis technicians that have appropriate privacy options. An often overlooked but essential office space is an appropriately sized meeting room that can be used for clinical handover, continuing professional development, or business meetings.

The schedule of accommodation should account for the communication equipment used for clinical and business operations management. Office space should be designed with cabling and capacity for a sufficient number of telephones (all compatible with an after-hours forwarding service) and the means to receive patient treatment information, such as via fax. Other options for communication might be desirable, such as the use of e-mail through a secured patient portal and video conferencing, and these may require additional design considerations.

Reception Area

Entry to the reception area should include a drop-off zone for patients that is adequately lit for security and safety and ideally covered for all-weather access. The building should have wheelchair access with a ramp and a wheelchair storage area near the exit in the reception area (Figure 7).

The reception area itself should contain a seating area and a warm and welcoming greeter desk (Figure 8). A greeter telephone is highly recommended: when no one is attending the reception area, this telephone rings through to all other rooms. A worthwhile investment is to ensure that the greeter desk is set up to also serve as an additional workstation for staff should the need arise. The reception area should have surfaces for educational materials, pamphlet dispensers, and bulletin boards for information from local patient support and advocacy groups. It is common to have a refreshment bar or a water cooler as a pleasant, value-added extra.

Workstations for Nurses and Clinical Dialysis Technicians

Clinical workstations should provide adequate surface space and storage for training and case management materials (Figure 9). There should be the ability to monitor patient arrival and treatment, but with sufficient noise control and privacy options to permit sensitive activities (eg, having discussions with patients, calling physicians for orders, entering clinical data, and performing other maintenance-related activities). In most cases, this requires a separate room with individual cubicles or workspaces. An increasingly popular option for the management of home dialysis patients is through telemedicine. In this case, a separate room will be required with telepresence and other technical equipment to allow for noise control and privacy.

Utility Rooms

The clean utility and medication room must have secure access and be able to store drugs and sterile consumables. There should be adequate bench space for drug preparation and shelving (Figure 10). The soiled utility room (sluice room) does not require secure access and should include a sink and hand washing facilities.

Figure 9. The Northwest Kidney Centers Home Dialysis Hub in Seattle: Clinical workstations for nurses and clinical dialysis technicians (courtesy of Aaron Herold).

Storage

Storage facilities should comply with local regulations and accommodate the types of supplies listed in Table 3. The schedule of accommodation should also allow for the equipment necessary for stock management and equipment tracking. There should be external access for deliveries and easy access for staff from the training and clinic areas.

Vehicle Parking

Vehicle parking is frequently overlooked in facility planning and is important for those who are either training or attending clinic at the home HD hub. Unlike facility HD patients, most home

Figure 10. The Northwest Kidney Centers Home Dialysis Hub in Seattle: Clean utility bench space and shelving (courtesy of Aaron Herold).

HD patients drive and are ineligible for free transport options. In the spirit of promoting self-management and independence, allocated on-site parking should be readily available for patients and their care partners. Parking must also be allocated for visitors with disabilities.

Staff who perform patient home visits are an integral part of any home dialysis service, and there should also be adequate parking for the on-site staff vehicle pool.

Machine Workshop

Not every program requires a workshop, and many will arrange machine servicing and repairs off-site. If a workshop is required, there should be adequate bench space for repairs and floor space for machine storage, with external access to allow for easy transport.

Common Break Room

It is important to provide a lounge for staff that incorporates lockers, a table(s) and chairs, and a refrigerator or kitchenette. This allows space for staff to place their belongings, take breaks, and eat in a room separate from the clinical work areas. Showers are not a requirement, but they allow staff more flexibility, if available.

Remote Monitoring Facilities

There are different options for remote monitoring available to home HD units and their patients, although they all have the similarity of providing a means of communication between home HD staff (physicians, nurses, and clinical dialysis technicians) and patients.[21] Remote monitoring allows staff to review and assess patient's treatment, observations, recordings, and general health status remotely, allowing the patient to live as independently as possible on home HD away from the hospital setting while still receiving a high level of care and support. In addition to providing staff with up-to-date information on patients at home, remote monitoring can also assist in easing some of the fears and anxieties of patients and their families about performing HD away from the hub.[22] For some patients, this will help them feel supported in an independent environment.

It is important to acknowledge the negative features of remote monitoring systems. First, there is significant cost associated with the technical elements of monitoring and staffing. This can be a financial burden for providers and a disincentive to home HD uptake. Another issue is a negative perception among some patients, who often find monitoring intrusive. Finally, it is unlikely that remote monitoring prevents serious adverse events; however, it is plausible that more timely access to patient observations (eg, weight and blood pressure) may improve routine patient care.[21,23] In general, more research is needed to clarify the role of remote monitoring, and many programs do not routinely offer it in the modern era.

Integrated Governance Structure

Service Delivery and Patient Care

The concept of governance refers to the activities that direct, administer, and control an organization. A framework for the governance of home HD programs is suggested in Figure 11 and describes the groups that guide service delivery and patient care. A formalized governance structure is important for these programs—there must be transparent accountability and linkages around all the critical processes that impact clinical outcomes. Accountability, in turn, refers to personal responsibility for delivering on these processes.

For every home HD program, there are either corporate or nonprofit bodies at the top of the governance structure that exercise ultimate authority. For corporate-governed programs, boards of directors (or their like) set policies that determine how the program runs to meet corporate goals and the nature of relationships among directors, management, and stakeholders (regulators, financiers, suppliers, employees, patients, the community at large, etc). For nonprofit-governed programs, boards of trustees or governmental groups set the policies instead. Whatever the structure, there are always normative and binding rules or standards that set overriding goals for the program and specify how the goals are met. Further discussion on governance options is outside the scope of this module, which instead focuses

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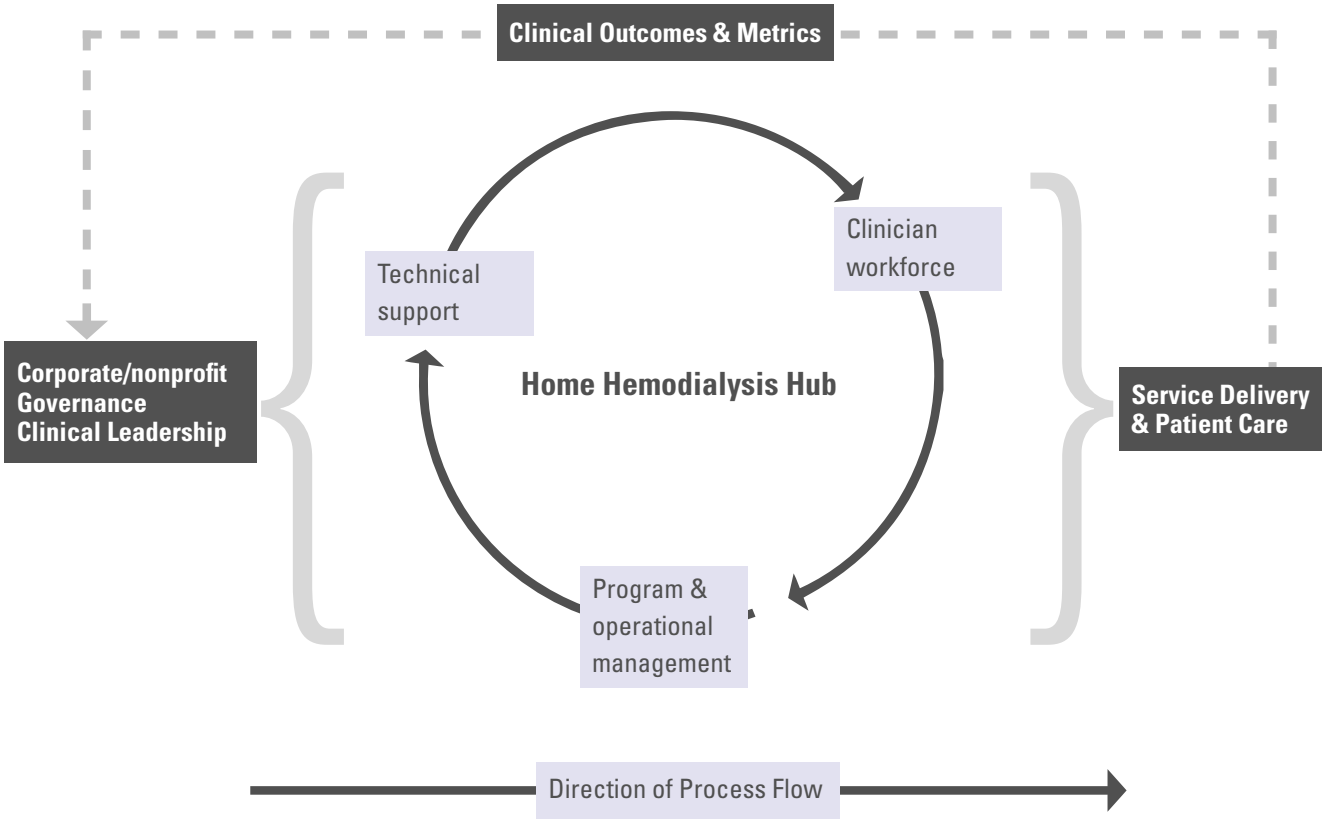

Figure 11. A framework for integrated governance of a home hemodialysis program or hub.

on the key accountabilities and linkages for those governance groups that function in the home HD program or hub: managers, clinicians, and technical staff. It is vital, however, that these individuals be aware of their organization's overriding strategic objectives and imperatives, and ensure that the processes for which they are accountable are aligned and compliant.

Clinicians play a key role in the governance of home HD programs. Management governance is usually "top-down" and related to business and regulatory concerns. Clinical governance is more distributive and relies on the expertise and engagement of healthcare professionals throughout the whole service. Ideally, management and clinical governance should coexist; this helps ensure that patient care and outcomes are the prime drivers in defining clinical service delivery and decision-making. In any home HD program (and arguably healthcare in general), strategies for clinical engagement should be formalized and allow clinicians to have a voice in decision-making processes and to lead clinical initiatives.[24]

The roles and responsibilities of managers, clinicians, and technical staff are summarized in Tables 5 through 7, respectively. In larger programs, there is often division of labor among many; in a smaller program, many of these roles and responsibilities might fall to 1 or 2 people in each group. Nonetheless, it is necessary only to know that tasks are being accomplished and

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Table 5. Roles and Responsibilities of the Program (Strategic) and Operations (Tactical) Managers in a Home HD Program

Key Accountabilities	Linkages	Examples
Financial	Business or finance service unit and analysts	• Key performance indicators for cost-effectiveness (eg, weeks per patient trained, home HD technique survival) • Capital budget and expenditure (eg, dialysis machinery and reverse osmosis units) • Operating budget and expenditure (eg, staff and consumables) • Contracts and procurements
Administration	Business or finance service unit and analysts	• Billing • Stock supply chain (eg, dialysis machinery reverse osmosis units, consumables)
Staff Management	Human resources service	• Recruitment and retention
IT and Database	IT service	• Procurement and upkeep of softwre and hardware to ensure business and clinical continuity
Communications	IT service	• Supply of fax, telephone, secure patient e-mail services, after-hours on-call redirect
Risk Management	Quality service	• Quality and clinical performance indicators • Patient safety • Occupational health and safety • Incident and complaints system

HD = Hemodialysis; IT = information technology.

that appropriate persons are held accountable, as determined by their professional role assignment.

A particular area of importance and shared responsibility is that of disaster recovery planning. Disasters such as hurricanes and earthquakes often severely disrupt power, water, and sewage utilities; even if utilities are not interrupted, supply chain disruptions may limit how long HD can be sustained at home. Large-scale disasters may also damage local in-center dialysis facilities, and acute hospital facilities are in high demand due to acute kidney injuries, so many patients must be transferred to other nearby programs. Evacuation of home HD patients during these events is typically the only feasible option. Establishment of organized disaster plans is recommended for all home HD programs. Managers, clinicians, and technical staff should identify alternative HD arrangements for their patients, educate patients about dietary restrictions, and establish evacuation procedures to allow the early transfer of home HD patients, along with their key documentation, out of the disaster area. Integration of the home HD disaster plans with those of local health authorities helps ensure alignment of transportation and logistics.[25] One such disaster plan has been published by NxStage Medical and is designed to facilitate emergency preparedness for home HD patients (available **here**). Another disaster plan was published following the February 2011 Christchurch earthquake in New Zealand, and is aimed at facilitating disaster recovery and management for home HD providers and the teams helping

Table 6. Roles and Responsibilities of the Clinical Leadership in a Home HD Program

Key Accountabilities	Linkages	Examples
Model of Care		• Care principles and organization of evience-based, patient-focused interactions between clinicians and patients • Multidisciplinary team care (medical, nursing, technical, pharmacy, physiotherapy, occupational therapy, social work, health psychology) • Home visiting program
Clinic Performance Indicators, Clinical Audit, and Case Reviews	Quality service, IT service	• Training time and failure rate • Home HD technique survival and drop-out rates • Vascular access survival and complication rates • Program recruitment rate • Hospital admission rate • Patient survival rate • Key performance indicators on clinical processes (monthly labs, home visits)
Risk Management		• Patient Safety (eg, "near miss" case conferences) • Home HD dropout (eg, drop-out case conferences) • Incident and complaints system
Maintenance of Clinical Standards		• Clinical policies and standard operating procedures • Product and technology evaluation • Criteria and audit of acceptance to home HD program
Research		• Abide by protocols and collect trial data
IT and Database	IT service	• Clinical data entry to ensure clinical continuity
Staff Management	Human resources service	• Recruitment • Orientation and onboarding • Credentialing • Continuing professional development
Clinical Capital Evaluation	Business or finance service unit, analysts	• Contracts and procurement

HD = hemodialysis; IT = information technology.

Table 7. Roles and Responsibilities of Technical Support in a Home HD Program

Key Accountabilities	Linkages	Examples
Dialysis Machinery and Reverse Osmosis Units (see "Infrastructure, Water, and Machines in the Home" module)		• Stock management • Maintenance and servicing • Technical troubleshooting • Home installations, particularly in relation to a safe and reliable water supply
Clinical Capital Evaluation	Business or finance service unit/ analysts	• Contracts and procurements (dialysis machinery, reverse osmosis units)
Staff Management	Human resources service	• Recruitment • Orientation and onboarding • Credentialing • Continuing professional development
IT and Database	IT service	• Technical data entry to ensure business and clinical continuity
Risk Management	Quality service	• Key performance indicators for water quality • Key performance indicators for machinery maintenance and servicing • Occupational health and safety • Incident and complaints system • Key performance indicators for compliance with technical standards (eg, electrical and plumbing standards)

HD = Hemodialysis; IT = information technology.

them.[25] Both are useful references for those programs developing their own disaster plans.

Options for Outsourced Home HD from a Large Dialysis Organization

Large dialysis organizations have many options for governance of home dialysis patients if patient care needs to be outsourced. Several models of training could occur, including (i) outsource training to a local facility but retain the patient once the training has been completed, (ii) outsource training and subsequent follow-up of the patient to a local facility, and (iii) training in a central location with referral to local dialysis units ("hub-and-spoke" model). The benefits and challenges of each model are described in the following subsections.

Outsource Training

If a dialysis facility does not have the capacity to develop a home HD program owing to staffing or building constraints, potential patients can still be trained for home HD by outsourcing training to an established home HD program. Programs can then have the patient return to the main dialysis facility for maintenance of care and evaluation by clinical staff (physicians, nurses, and clinical dialysis technicians) on a regular schedule. An example of this type of model is the training of pediatric patients and families. In this example, the parent facility may not have sufficient experience or infrastructure for the task and may

choose to outsource. Clinical staff at the parent program can be trained in the specifics of the home HD technique and related troubleshooting; however, the training itself, machine care, and standard maintenance are taken care of by the training dialysis program. Appropriate agreements for emergency issues, machine maintenance, and respite care must be in place for this model to be successful. The prime benefit to the parent dialysis program is that it can offer home HD but does not need to invest in the training infrastructure to maintain this modality.

Outsource Training and Follow-up

Another model that can be used to offer home HD is to outsource training and subsequent follow-up of home HD patients by partnering with a local established home HD program. In this model, patients are recruited by the parent dialysis program, but all home HD training and subsequent follow-up is performed by the outsourced organization. The benefits of this model are that it allows the parent dialysis program to offer home HD to all patients potentially closer to where patients live; however, it does not facilitate direct management of patients by the parent facility. Difficulties with this model are loss of control of management of dialysis patients and the need for a liaison for referral when issues arise with dialysis access or need for emergency dialysis. Quality metrics and oversight must be in place to ensure that referred dialysis patients are receiving quality dialysis care.

Hub-and-Spoke Model

Large dialysis facilities or health maintenance organizations that offer dialysis can potentially use a model that relies on regional training of home HD with subsequent follow-up in smaller units. This centralized hub-and-spoke model has been used in the US Veterans Health Administration for the evaluation and treatment of patients with spinal cord injury. Patients are referred to centralized regional centers of excellence but receive traditional care at smaller local centers. This model allows overall evaluation of all potential patients for home HD in a regionalized central location that can offer experience and long-term follow-up options. Challenges with this model are that local expertise is needed for daily emergencies and respite dialysis, and patients will need accommodations close to the regional center for the duration of their training. An example of this type of model would be to have a large centralized HD training center that refers patients to local, more rural spokes that can then take care of minor emergencies. All machine repairs and patient training are completed at the regional center of excellence, and all minor issues are dealt with closer to the patient's home.

Conclusion

A well-functioning home HD program critically depends on adequate hub facilities and support functions and transparent and accountable organizational processes. The likelihood of optimal service delivery and patient care will be enhanced by fit-for-purpose facilities and implementation of a well-considered governance structure.

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