

# Safety Innovations

## Pediatric Home Service (PHS)

### **Innovations in Managing Pediatric Home Medical Equipment**

Enabling pediatric patients (with medical complexities)  
to live safely and successfully at home

It is highly unusual for AAMI or the AAMI Foundation to single out a for-profit organization as illustrating valuable practices, especially without any significant research, metrics, or peer review to back up the story. We have learned a lot about the home healthcare space in the past year since we published an issue of "Horizons" devoted to the subject and hosted the 2013 AAMI/FDA Summit on Healthcare Technology in Nonclinical Settings. It is a unique space and there aren't a lot of role models, standards, or illuminating stories to share about how to do home healthcare the right way. For that reason, we made an exception. From our limited but growing knowledge, PHS has a model and standard operating practices that others may find helpful. We don't know if they do everything right, we didn't interview their customers, and we certainly are not endorsing them over any other high quality home health organization (yes, this is a disclaimer). Our goal is to illuminate practices that help others envision a better way as healthcare moves out of the hospital and into the world at large.

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#### **About the Healthcare Technology Safety Institute (HTSI)**

Founded within the AAMI Foundation, the 501(c) (3) charitable arm of AAMI, the HTSI is a community of leaders throughout the healthcare system that are dedicated to one common vision, "No patient will be harmed by medical technology." HTSI's mission is "To engage the entire healthcare community in multidisciplinary safety initiatives that strengthen the development, management, and use of medical technology for improved patient outcomes." HTSI engages the healthcare community in research, education, consensus, and partnerships related to the challenges facing healthcare technology industries, regulatory and accrediting bodies, clinicians, caregivers, and patients.

#### **From IEC 60601-1-8:2006, Medical electrical equipment – Part 1-8: General requirements for basic safety and essential performance**

– Collateral Standard: General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems

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# Pediatric Home Service (PHS)

## At a Glance

<b>Subject:</b>	Pediatric Home Service (PHS)
<b>Location:</b>	St. Paul, MN
<b>Description:</b>	Pediatric Home Service is an independent pediatric home care company that helps children with medical complexities and technology dependencies live safely and successfully at home.

## Introduction

Managing the care of a typical Pediatric Home Service (PHS) patient can be incredibly complex. More than 80% of PHS home care nursing patients are designated high acuity, with illnesses ranging from cerebral palsy to congenital heart defects to cancers and chronic lung disease. Many of them are dependent on multiple advanced medical technologies to survive. These patients require a level of care that demands the advanced skills, experience, and technologies typically found only in hospital intensive care units. Yet, they are living at home, with their parents, where they get to be just kids most of the time, not patients. How is this possible? With the coordinated team efforts of one of the country's leading independent pediatric home care companies and its partners: leading hospitals, physicians, and nursing agencies in the Twin Cities region.

Since it was founded in 1990, PHS has been working to support extremely ill patients in the home environment. "We offer a medical home model, not just durable medical equipment (DME)," says Roy Maynard, MD, FAAP, the medical director for PHS. "We have developed a coordinated approach, using a team to meet children's health needs." Along the

way, PHS has innovated several best practices that can serve as a model for other home healthcare providers, both pediatric and adult. By carefully managing patient transitions to home, providing extensive patient education, and effectively managing complex medical technologies in the home environment, PHS is helping the very sickest kids survive—and often thrive—at home.

## Background

PHS was a pioneer in adapting hospital equipment to home use. It started out in 1990 as a small respiratory business with only six employees. "Some practicing pediatric subspecialists decided to try to take ventilators into the home," says Maynard. In those early days, ventilators were designed for hospital use, not home use, and for adults, not children.

"Our goal was just to ensure that children had the right to grow up in their homes, not in the hospitals," says Susan Wingert, PHS founder. "And it was revolutionary in the early 1990s. It only happened because we had a group of pediatric pulmonologists who came in and said, 'These kids don't belong in the hospital, let's get them the heck out.' And they did."

"In the early days, we needed three machines to do one thing," says Derek Hus-

## Pediatric Home Service Provides:

- Infusion Nursing & Pharmacy
- Respiratory Therapy
- Home Care Nursing
- Specialized Nutrition Services
- Social Work Services
- On-Site Medical Director
- Biomedical Specialties, Constant Technological Research and Comprehensive Clinical Support
- Education and Training for Nurses, Parents and Other Caregivers

Equipment offered by PHS includes the following:

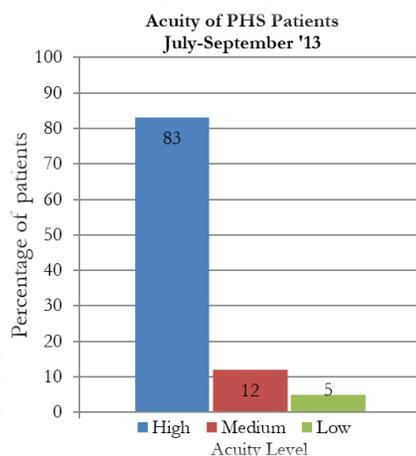
- Ventilators
- Monitoring systems
- Heated humidifiers
- Suction equipment
- Oxygen supplies
- Airway clearance
- Formula
- Asthma supplies
- Food pumps
- IV pumps
- Wound management supplies
- Ostomy supplies
- Nebulizer, cup, and compressor supplies
- High-flow nasal cannula systems
- Noninvasive ventilation

vet, PHS's director of respiratory service. "Equipment had to be improvised." Over time, attitudes have shifted in favor of keeping patients at home, and industry has responded with new technologies. Today, more devices are designed for the pediatric population and for home use.

PHS has grown as well, now employing over 350 people and providing a broad spectrum of specialized hospital-quality care in the home including respiratory therapy, infusion nursing & pharmacy, home care nursing, and clinical support services. They work with four different children's hospitals in the Twin Cities area, offering equipment such as ventilators, monitoring systems, infusion pumps, nebulizers, and much more.

"Technology has leapfrogged and is now much more sophisticated," says Rebecca Long, PHS's director of ancillary services. "Equipment today is more portable, more powerful, and more integrated. It can also be more complicated. More patients are surviving today, and the complexity of their illnesses is growing."

Keeping children at home requires that all of these powerful, complex technologies be operated outside of a controlled hospital environment. Parents looking to bring their children home must also face bringing these complex technologies home.



83 percent of PHS patients were considered high acuity between July and September 2013. 12 percent were medium acuity, and 5 percent had a low acuity score.

Supporting those parents in the home is the mission of PHS, as is evident from the philosophy published on their website: "We are driven by the belief that even if a child's organs are outside his body or if her legs are wheels, that child wants to be a 'kid.' That child wants to do all the typical kid things, whether it's going to school, playing with the dog, or bickering with a sibling—and they want to do it at home."

## Top ten medical conditions affecting PHS respiratory patients

- Cerebral Palsy (CP)
- Chromosomal abnormalities
- Chronic Lung Disease/Bronchopulmonary Dysplasia (CLD/BPD)
- Congenital Heart Defect (CHD)
- Duchenne Muscular Dystrophy (DMD)
- Muscular Myopathies
- Pierre Robin Malformation
- Quadriplegia
- Spina Bifida
- Spinal Muscular Atrophy (SMA)

## Top ten medical conditions affecting PHS infusion patients

- Autoimmune disorders
- Congenital abnormalities
- Osteomyelitis
- Glycogen Storage Disease
- Immunodeficiency
- Short Bowel Syndrome (SBS)
- Cystic Fibrosis (CF)
- Childhood cancer
- Mastoiditis
- Wound infections

## Transitioning Home, With Equipment

Managing the transition from the hospital to the home is the first step in caring for children with medical complexities at home. For most parents, the prospect of caring for an extremely ill child and

operating complex medical equipment is initially daunting.

Rebecca and Chad, parents of a PHS tracheostomy patient, are featured in a video developed by PHS to help parents make that leap into caring for children in their homes. Their story illustrates how much the support provided by PHS helps. Their daughter was undergoing surgery for insertion of a tracheostomy tube, which is more comfortable for ventilating patients long-term than a breathing tube that goes down their throat into their windpipe. In the video, Rebecca, the mother, explains, “Once she [her daughter] came out of surgery and she had that trach, it was just like, calm baby, calm kid . . . She needs it. It helps her. Twenty or thirty years ago, she would be living in the hospital.”

In the discharge process, parents are told that they are an important part of a team and that they will have physicians, nurses, and discharge planners to help them through every step of the process. “People are going to get you prepared in the hospital to go home,” says John Sheahan, a respiratory therapist, to the parents in the video. “Before you go home, we’re going to come out, we’re going to do education with you, and we’re going to check your home. We’re going to make sure everything is good, make sure everything gets set up. It’s a step-by-step effort and we’re all going to work together. And when you go home, you’re not going to be alone either. It’s an ongoing team effort.”

PHS has refined the discharge process over the years, in concert with its patient education team and its biomedical staff. Key steps include the following:

### **1. Begin the discharge process**

When children with medical complexities are first identified to go home, a hospital’s care manager coordinates the transition. The physician in charge decides what equipment and home care services are needed to allow the child to go home safely. When PHS is chosen to supply equipment, as it most often is in high-acuity cases, its staff becomes a key part of the patient care team.

### **2. Determine appropriate equipment**

Physicians typically work closely with PHS in deciding what equipment will follow the child into the home. “The physicians must work with what’s available and must be well versed on the home care equipment,” says Long.

PHS and the hospital care managers also work with insurance companies or other payers to make sure the chosen equipment is financially feasible for the family. PHS social workers help the patients navigate financial and insurance programs; PHS dietitians create home parenteral nutrition plans; and PHS infusion pharmacists work closely with nurses to ensure all medication needs are met.

Reimbursement for equipment can be a major struggle in home care. PHS staff help parents navigate these issues at the patient level. At the policy level, PHS executives and lobbyists have been at the forefront of working with private payers and state and federal agencies to help ensure that these technologies are available to support caring for patients at home.

### **3. Create a safe care plan**

The team then coordinates on the creation of a safe care plan customized for the child in the home environment. It requires the involvement of the physician and members of the PHS care team, often including a respiratory therapist, infusion nurse, dietitian, specialty pharmacists, social worker, home care nursing, and of course, the parents (caregivers).

The safe care plan includes a backup plan for all equipment. “We often need two of each piece of life supporting equipment in case of a medical device failure” says Long. Battery usage must be considered, as most homes have no backup generators. PHS and its equipment staff also serve as a go-between for a family on high alert and utility companies, who are informed of the need for continuous power.

### **4. Train caregivers on equipment and care plan**

Home caregivers must be trained to operate, clean, and maintain equipment; handle supplies; and in some cases, even

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## PHS Home Environment-Falls-Vulnerable Persons Assessment

This 88-point checklist was developed by PHS clinicians, physicians, and biomedical equipment staff in order to assess the home environment and prepare it for bringing home acutely ill children with complex medical equipment.

perform medical procedures. Selection of PHS's patient education materials is customized for each family to address such issues and are often delivered with extensive one-on-one training in the hospital before discharge.

In the case of Rebecca and Chad, they had to learn how to change a tracheostomy tube before going home. "We had to immerse ourselves in the hospital so we felt confident going home. That built our confidence more than we knew. We were ready to come home with her because we were able to do everything for her," said Rebecca. "It's empowering. Once you feel like you have a handle on this, you can take your child home and you can start living your life again."

### **5. Ensure that caregivers use the equipment before leaving the hospital**

One key to success is to make sure that all caregivers are experienced with the equipment before leaving the hospital. To this end, PHS often brings its equipment into the hospital for parents to use prior to discharge. "Generally, all tracheostomy and ventilator patients are placed on the equipment they will be using at home for two to four weeks before leaving the hospital," says Maynard. This experience helps build confidence and "muscle memory" for responding in emergency situations. "We want the child's healthcare to become routine, part of their lives, second nature—really, no different than changing a child's diaper," says Maynard.

### **6. Conduct a home assessment if required**

In many cases, PHS requires a home environment assessment, an in-person inspection conducted by PHS clinical personnel who have been trained by the PHS biomedical staff to consider equipment issues and look for potential safety hazards. They use a four-page checklist to guide the inspections, considering questions regarding, for example, where to place the equipment or required safety or electrical improvements. "We are really setting up an intensive care unit in the home," says Hustvet.

The home assessment includes such items as the home's outlets, stairs, safe storage of prescribed medications, and emergency backup plans for extended power outages and severe weather. The family, PHS, and the physician all work together to ensure that all concerns are addressed before the child goes home.

For high-tech patients, PHS will also help the family determine the most appropriate place for the child and all the equipment to be set up, which is not always the child's bedroom. The goal is to integrate each child into the family home life as much as possible. Often, the living room or anywhere the family spends the majority of their time is the best solution, especially if the child will have limited mobility.

The findings of the home assessment are shared and the three parties (family, PHS and physician) all work to ensure any concerns are addressed and fixed before the child goes home.

### **7. Meet the family in the home upon discharge**

When the child is actually discharged, PHS clinicians will meet the family at the home to review equipment and provide individualized training and educational materials for the home setting. They want to ensure that the family and all caregivers are comfortable with the necessary care before leaving the child at home.

### **8. Maintain ongoing contact**

Even once the child is settled in the home, the close relationship with PHS continues. There is ongoing communication between PHS and the family, physician, and any other collaborating healthcare partners such as extended hours nursing agencies or any other medical supply companies. Close contact is maintained to ensure that the child is adapting and growing properly. Families also call PHS to order supplies as necessary. Depending on the equipment in the home, there may be ongoing visits from PHS clinicians to assess progress.

## Training & Education Materials for Caregivers

Parent and clinician education is a large component of patient safety. “Home caregivers need to know both routine care and emergency care,” says Maynard. The staff at PHS work hard to deliver both hands-on training and effective education materials. They also follow up on those materials with evaluations to ensure understanding.

### Parent Training

As described earlier, even before patients are discharged from the hospital, PHS trainers meet with parents to begin teaching them how to use equipment safely. Similarly, PHS trainers also work with nurses from other companies to ensure that everyone is up to speed on the equipment.

“Training both parents and in-home caregivers is essential,” says Judy Giel, senior vice president of clinical services at PHS. “This is equipment that is typically used by professionals. We also test users to ensure that their emergency response skills are sufficient.”

User error or interference with equipment is a real risk in the home environment, and PHS trainers work to minimize that risk. “Education is needed so that they will understand the equipment,” says Hustvet. “People in the home could inadvertently switch settings or disable alarms, babies could pull out connectors, or siblings could interfere with equipment. Even contractors in the home could create problems.”

“It’s a reality,” says Hustvet. “We try to mitigate that by changing defaults, trying to plan for the family to make mistakes, and teaching them how to respond. We have to make sure others are aware of the patient and the equipment, and educate them on the risks. Education can make a difference.”

PHS clinicians use the information gained through the home assessment and their understanding of the clinical picture to help in this process. By building a relationship with the family, setting realistic expectations, clarifying the roles of various health professionals, and providing training and education materials as needed,

PHS aims to minimize inadvertent problems and train home caregivers to respond to them when they occur.

### Clinician Training

PHS maintains an extensive training program for its own clinicians and beyond. Its trainers are called on to train new nurses outside its staff, and they even offer classes to the community. They also reach out to new home care nursing companies to introduce them to PHS services and offer them equipment training.

“Staff training is important,” says Sandi Maguire, PHS’s managing director of home care nursing. “Home care nurses work with complex equipment. A pediatric nurse is on his or her own in the home, without the resources available in the hospital. Therefore, we focus much of our attention on training.”

“The level of training we require is very high,” agrees Maynard. “New clinical staff may train for up to six months before they are allowed to go out into the field independently.” PHS also requires higher levels of certification than typical home care companies, as well as ongoing training competencies. Training can also be provided during weekly staff meetings. Managers go on annual “ride-alongs” with staff to ensure competencies.

PHS University is an online learning management system that pulls together learning blocks for employees and maintains competencies. It offers training modules and requires clinicians to take quizzes to demonstrate their understanding. If they do not pass with 90% or higher in three attempts, they are provided additional training.

Training programs are developed for specific equipment as soon as PHS chooses to carry that equipment. PHS trainers have input into the equipment selection process. Initial training is provided by manufacturers or PHS biomed staff to the training staff, who then develop their own training modules and competency training to be used in certifying staff on equipment use. These efforts also feed into the development of patient training and patient

education materials. All training and materials are reviewed and tested extensively to ensure that they are as accurate and effective as possible.

“This training effort is an investment by PHS as a company,” says Long. “We believe in well-educated caregivers and parents. This is key to fulfilling our mission. We want to keep patients safe, decrease the amount of time they spend on the equipment, and keep the best interests of the child at heart.”

### **Patient Education Materials**

Hands-on training is only one step in the education process. PHS also offers an extensive library of written and electronic education materials that its own staff has created. The company provides individualized training materials for home use for every patient: Each family receives a customized three-ring binder containing only those materials that are relevant to their situation.

Early on, PHS held patient focus groups to determine how parents wanted to receive written training materials. From that early input, along with the growing demand for nurse training, the program grew to its current size. PHS now has an entire in-house department focused on preparing patient education materials in a variety of formats, including posters, checklists, quick reference guides, user manuals, DVDs, and even training videos. They specialize in taking those famously complicated instructions for use that come with medical equipment and making them clearer and more accessible. PHS translates vital education materials into three languages to serve the local population.

“Patient education documents that are intimidating to open and difficult to understand create safety issues,” says Long, head of the division that creates PHS education materials. “We take manufacturer instructions and add pictures and do plain language editing to make the information more quickly understandable. Clear instructions are a benefit to every patient and caregiver, regardless of education level or birth language.”

The process of developing education materials begins as soon as PHS decides to offer a new piece of equipment. Long and her team start by looking at the manufacturer’s literature, including service manuals and operator manuals for both patients and clinicians. All manufacturer documents are scanned into their online document management system and made available to staff as PDFs through their online portal.

While manufacturers are required to provide instructions with all of their equipment, Long says that these documents are often less than ideal for use in a home setting, especially when a family must use multiple pieces of equipment. “Those manufacturer manuals are not written at a fifth- to eighth-grade reading level. They are all organized differently, and are overwhelming with descriptions of multiple equipment and supplies. They are too thick, intimidating, and full of legalese, cautions, and warnings. Our goal is to take these complicated instructions and make them consistent and easy for parents and home care nurses to use.”

Even during the equipment evaluation process, the team begins to write work instructions, capturing tips and tricks on operating equipment from clinical staff. The biomedical department evaluates service manuals to ensure that the equipment can be safely operated, cleaned, and maintained in the home environment.

Patient education materials are then developed following plain language principles. The goal is for the content and organization of the material to be meaningful for caregivers and the text to be at a 5th grade reading level. PHS creates detailed step-by-step pictures and adds short instructions below each image. The materials are designed for use by both the parents and the nurses.

All materials are put through an extensive review process by clinical and nonclinical staff and a plain language editor. Four clinicians currently split those duties, with one respiratory clinician, one infusion nurse, and two dietitians involved. They add specific instructions for accessories as well, getting as granular as possible



PARI Neb (Nebulizer) Kit	
Equipment	2
Supplies	2
Parts of the PARI Neb Kit	3
Setting Up the Neb Kit	4-5
Using the Neb Kit	6-7
Troubleshooting	8
Cleaning	9

What is a Neb Kit?  
A Neb Kit, when connected to a nebulizer, delivers medicine directly into your child's lungs.

Read all manufacturer's warnings and cautions before operating equipment for the first time.

PHS Education  
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Welch Allyn Blood Pressure Monitor	
Equipment	2
Supplies	2
Parts of the Blood Pressure Monitor	3
Parts of the Display Screen	3
Parts of the Pressure Hose	4
Parts of the AC Power Cord	4
Parts of the Blood Pressure Cuff	4
Operation	4
Setting Up the Blood Pressure Monitor	5-6
Using the Blood Pressure Monitor	7-9
Determining the Correct Blood Pressure Cuff Size	10
Alerts	11
Power Sources	11
Troubleshooting	12-13
Cleaning	14

What Does a Blood Pressure Monitor Do?  
A blood pressure monitor checks your child's blood pressure and heart rate.

Blood pressure is the pressure on the walls of blood vessels as blood moves through the body.

Heart rate is the number of times the heart beats each minute.

Read all manufacturer's warnings and cautions before operating equipment for the first time.

PHS Education  
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in their descriptions so that nothing is left unsaid. A publications coordinator takes photographs and helps assemble documents, and several other administrative staff help run a print house to laminate and print documents and prepare binders so that clinicians can easily customize them.

Every device user guide is organized and formatted in a similar way. The cover page includes the name of the device, a photo of the device, a table of contents, a description of the device, and a short statement on how to use it and why it is important. Typical sections inside the guides address equipment, supplies, parts of the device, setting up the device, using the device, troubleshooting, and cleaning. The documents include specific reorder numbers for equipment and supplies, with pictures of each supply included by its reordering information. “The goal is to clearly describe for parents and nurses what they have to do to set up, use, and maintain the equipment every day,” says Long.

All materials are put through an extensive review process by both clinical and non-clinical staff, patient families, and plain language experts. When complete, all materials are also made available on the electronic document management system.

“We have a library of more than 300 unique education documents. We continu-

ally add to them, and we continue supporting old devices as long as any patients are still using them,” says Long. “In addition to equipment user guides, PHS also offers other informational documents like a safety checklist for families who are traveling with a child with medical complexities and fire prevention guidelines.

Other patient communication efforts include regular newsletters and an active email outreach program to share technology changes as needed to keep everyone up-to-date on equipment.

Recently, PHS has expanded its patient education efforts into the world of video. They plan to produce several one- to six-minute how-to videos that clearly and simply describe how devices operate and make them available to patients and staff for reference and training via the PHS website. Visuals include tight frames on equipment and operators; audio includes voice-overs that can be recorded in other languages as needed. Their plan is to focus first on creating videos addressing problem areas that generate the most phone calls for troubleshooting and help.

### Ongoing safety campaigns

PHS goes beyond simply offering education materials and training. They actively test their caregivers—both clinicians and

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## Plain Language Guidelines

The Center for Plain Language offers these guidelines for creating clear, understandable documents:

- Identify your audience
- Write in active voice
- Keep it short
- Use personal pronouns
- Write in a visually appealing style
- Don't be wordy
- Structure your writing
- Use graphics and tables
- Use parallel phrasing
- Do not use and/or
- Avoid "shall"
- Don't use unnecessary qualifiers
- Don't use multiple negatives
- Avoid redundancies
- Test your document

parents—to ensure that skills are being mastered and retained. They have developed several safety campaigns to support these efforts and have used those to improve all of their training programs.

One safety campaign began when PHS officials noticed that several calls were coming in with panicked caregivers. “We were receiving more emergency calls, and it was obvious that people were not comfortable with certain procedures,” says Long. Staff examined the calls to identify problem areas and developed a 38-question test on home safety to use as a survey of competency of home care clinicians and parents. Their staff visited the homes of 85 patients to see if the caregivers could demonstrate the skills necessary for effective day-to-day and emergency care. As a result, a number of problem areas were identified for both parents and clinicians, and PHS realized they had to do a better job with education.

They began developing several interventions and rolled those out as a coordinated effort called the STAR kit, a collection of education materials and tools designed to enhance patient safety in the home. The kit includes informational DVDs, safety checklists and reminders, troubleshooting guides, equipment tags, and an emergency action plan. “Training was provided and the STAR kit was given free of charge to PHS families, home care providers, and referring physicians,” says Long. It became a permanent part of PHS’s education program. It was tested, adjustments were made, and its effectiveness is verified as new patients are discharged to the home environment.

Since then, other safety improvement initiatives have been rolled out, including an infection prevention campaign called “1-2-3 Infection Free” that has significantly reduced central line site infections.

“Our 2007 STAR campaign was great,” says Long. “It changed the way we educate, the way nurses work in the home. We’ve since given it to other nurse agencies and asked them to use it, and even invited new agencies in for training.”

“It’s all about building relationships,” she adds. “We want caregivers to be able to

respond to emergencies, to be able to rely on muscle memory in crisis situations.”

The efforts are part of their ongoing focus on quality and safety. “If we see any data, any survey or study, or any kind of trend that indicates a problem with a piece of equipment or a concept, we reconsider our training. We are constantly trying to find ways to improve,” says Long.

## CHECKLIST: How to Prepare Effective Patient Education Materials

- Follow accepted plain language principles
- Rely on subject matter experts for content
- Keep all materials at a third- to fifth-grade reading level
- Include no more than four pictures per page
- Place short descriptions of actions under photos or illustrations
- Allow for multiple document reviews, including non-clinical employees and patient families

## Equipment Management

The success of PHS in managing complex medical equipment in patient homes is due in large part to its commitment to following best practices in equipment management. The company maintains an eight-person, in-house biomedical department that includes three certified biomedical equipment technicians—a large biomed staff compared to most home medical equipment companies.

Mike Vogel, the biomedical supervisor, joined the company 15 years ago in what was then its equipment processing department. “At that time, it was just me, one other technician, and our boss. No one was certified,” he says. Over the years, his responsibilities grew and he began running into problems with manufacturers not wanting to provide parts for the equipment he was responsible for maintaining. When he decided he wanted to seek certification, Mike turned to his local biomedical

association, the North Central Biomedical Association, for support. He became certified in 2008.

One large part of his department's responsibilities involves training clinicians on how to use equipment and how to conduct environmental assessments. They assist in the creation of patient education materials. They also have most of the responsibilities of a typical hospital-based biomed department, with a twist: They must ensure that all equipment is safe for use on a pediatric population, in the home environment.

### **Equipment Selection**

The equipment PHS provides its patients must be both reimbursable and compatible with that used in its partner hospitals, as well as kid- and home-friendly. Balancing these competing needs through purchases in a medical marketplace that is just beginning to respond to pediatric and home-based patients can be a challenge. That is why, when updates are needed, PHS relies on its New Equipment Integration Process (NEIP) group to select the right equipment.

"The NEIP is the process we follow for onboarding new equipment," says Vogel. "We convene a cross-functional group to evaluate any new purchase, so all bases are covered." When new healthcare technologies are being considered, the NEIP tests them and shares results. Potential new equipment is reviewed by a multidisciplinary team for safety, effectiveness, and maintainability; by clinical staff for usability; and by PHS billing staff for financial feasibility. On occasion, new items are frequently tested in a patient's home as well.

"When we evaluate new technologies, we also have to talk to our local health care professionals and consider the impacts of those technologies in both homes and the hospital," says Maynard. "I regularly review equipment options with colleagues and discuss potential problems."

Maynard cites the example of a new vibrating mesh nebulizer technology as one the NEIP decided not to stock. "This new technology was very expensive and not

documented to perform better. We had no reimbursement codes for them, so we decided not to carry them. In another case, we decided that a trach adapter with a removable piece posed a choking hazard and could not be safely adapted for use in the home setting. If equipment is risky, not reimbursable, or not well tested in the home environment, we cannot carry it."

PHS also tries to standardize its equipment and supplies. This practice serves to both cut costs and improve safety. "We can't afford to maintain equipment, educate caregivers, and stock supplies for off brands," says Maynard. "We cannot expect caregivers or physicians to learn multiple complex systems. We need to focus our lines on two to three items to reduce both training and safety issues."

### **Equipment Innovation**

In the early 1990s when PHS was founded, very little equipment was designed specifically for the pediatric population, and even less was designed for home use. Staff frequently had to improvise equipment to meet their patients' needs. Today, more equipment is available for the home pediatric market, and PHS has been helping to make that shift a reality.

"Pediatric home care is still a very small part of the total equipment market," says Maynard. "There is not much equipment designed specifically for that population." When manufacturers do aim to target that population, they often come to PHS for help. "For example, a ventilator manufacturer came to us for input on the use of their product in home care. We've also been involved with developing new infusion pumps for home use."

Manufacturers will bring new medical devices to PHS pre-market, when they are still at the development stage. Testing in the home environment can reveal hidden flaws. For example, while a five-foot breathing circuit on a ventilator may be plenty long in a hospital, it may be too short in a home environment where children are freer to move about and play.

Vogel points out that in some situations his team has had to modify or even invent

equipment themselves for the home environment. “For example, in a hospital, you have high-flow air and oxygen in the wall, but you don’t have that at home. We came up with a way to create a home system for that purpose,” he says. His group also shares ideas and needs with DesignWise Medical (<http://www.designwisemedical.org>), a nonprofit medical equipment company that specializes in developing orphan products for the pediatric market.

### Healthcare Information Technologies (HIT) in the Home

In the hospital community, a massive effort is currently underway to make healthcare information available electronically for sharing and recordkeeping purposes. According to PHS, the home care market is not yet feeling the full impacts of that revolution.

“Some of our children are the sickest of the sick, and most have in-home nurses, so

## Encouraging Kid- and Home-Friendly Device Designs

— From PHS newsletter “The Pulse,” Fall 2012:

“PHS biomedical staff often work with the manufacturers to evaluate real-life situations that they don’t necessarily foresee or consider. Because children and adults will interact with their equipment differently, the way it functions and performs will be affected. Although manufacturers may say ‘that piece of equipment isn’t supposed to be handled or used that way’, the reality is that children move and play with their vent or food pump in ways that the adult population does not. PHS wants to ensure the manufacturer understands that.”

PHS Awards and Recognitions	
2014	<ul style="list-style-type: none"> <li>• AARC, Quality Respiratory Care Provider</li> <li>• PHS named a Center of Excellence by Passy Muir</li> <li>• Star Tribune Top Workplace-               <ul style="list-style-type: none"> <li>– Third among midsize companies</li> <li>– Meaningfulness Award- for an organization whose employees find the work they do to be meaningful.</li> </ul> </li> </ul>
2013	<ul style="list-style-type: none"> <li>• PHS Medical Director named a Top Doctor by Mpls. St. Paul magazine for Pulmonary Medicine</li> <li>• AARC, Quality Respiratory Care Provider</li> <li>• Star Tribune Top Workplace               <ul style="list-style-type: none"> <li>– Fourth among midsize companies</li> </ul> </li> </ul>
2012	<ul style="list-style-type: none"> <li>• Joint Commission Accreditation-Gold Seal (every 3 years)</li> <li>• Star Tribune Top Workplace               <ul style="list-style-type: none"> <li>– Sixth among midsize companies</li> <li>– Ethics Award- for an organization that continually keeps ethical business practice at the forefront of decisions.</li> </ul> </li> <li>• AARC, Quality Respiratory Care Provider</li> <li>• ADDY Award for Marketing Materials</li> </ul>
2011	<ul style="list-style-type: none"> <li>• Star Tribune Top Workplace               <ul style="list-style-type: none"> <li>– Third among midsize companies</li> <li>– Management Awareness Award for a knowledgeable management staff that keeps its employees well informed</li> </ul> </li> <li>• AARC, Quality Respiratory Care Provider</li> </ul>
2010	<ul style="list-style-type: none"> <li>• AARC, Quality Respiratory Care Provider</li> <li>• ADDY Award for Marketing Materials</li> </ul>
2009	<ul style="list-style-type: none"> <li>• 2009 Organization of the Year Award- NAPNAP</li> <li>• Certificate of Distinction for Asthma- Joint Commission</li> <li>• Joint Commission Accreditation-Gold Seal (every 3 years)</li> </ul>
2008	<ul style="list-style-type: none"> <li>• Communications competition sponsored by the Twin Cities Chapter of the Society for Technical Communication (STC)               <ul style="list-style-type: none"> <li>– Distinguished Award in Community Technical Publications for a DVD entitled “Home Oxygen Use,”</li> <li>– Excellence Award in Technical Art for “Asthma and You – Tip Cards,”</li> <li>– Merit Award in Online Communications for “1-2-3 Infection Free.</li> </ul> </li> </ul>
2007	<ul style="list-style-type: none"> <li>• Certificate of Distinction for Asthma- Joint Commission</li> </ul>
2006	<ul style="list-style-type: none"> <li>• Joint Commission Accreditation-Gold Seal (every 3 years)</li> </ul>
2003	<ul style="list-style-type: none"> <li>• Joint Commission Accreditation-Gold Seal (every 3 years)</li> </ul>
2000	<ul style="list-style-type: none"> <li>• Joint Commission Accreditation-Gold Seal (every 3 years)</li> </ul>
1997	<ul style="list-style-type: none"> <li>• Joint Commission Accreditation-Gold Seal (every 3 years)</li> </ul>
1994	<ul style="list-style-type: none"> <li>• Joint Commission Accreditation-Gold Seal (every 3 years)</li> </ul>

remote monitoring is not yet an issue for us,” says Maynard. “They can deteriorate in hours, not days, so our caregivers often must be on-site. While all of our computers have Skype capabilities and are capable of ‘telemedicine,’ many physicians are still trying to work out reimbursement issues.”

Because PHS works with physicians from many different hospitals, they must also work with different electronic medical record systems. “PHS coordinates these different services and has electronic medical charting in the home, but we sometimes run into challenges with what is being required,” says Maguire. They use secure email to transfer data.

“For a sleep study, we’ve been recording information and do a direct download to transfer information to the main facility,” says Hustvet. “It definitely speeds things up!”

### Problem Resolution

As every hospital knows, even the most carefully selected, well-maintained equipment can fail on occasion. Many of the equipment safety problems seen by PHS are not much different from those seen in hospitals. However, because PHS children are often so complex and sometimes located so far from the nearest medical facilities, even minor equipment problems can become big safety problems. The financial

impacts can also be huge when a child must be readmitted to the hospital to continue care. To minimize those impacts, the company works with insurance companies up front to make sure that every child’s safe care plan includes backup equipment—such as backup ventilators, feeding pumps, and secondary suction machines.

Trained clinical staff are available 24/7 to field problem calls and troubleshoot. The call-in number is published prominently on all PHS materials; stickers with the phone number are placed on every piece of equipment.

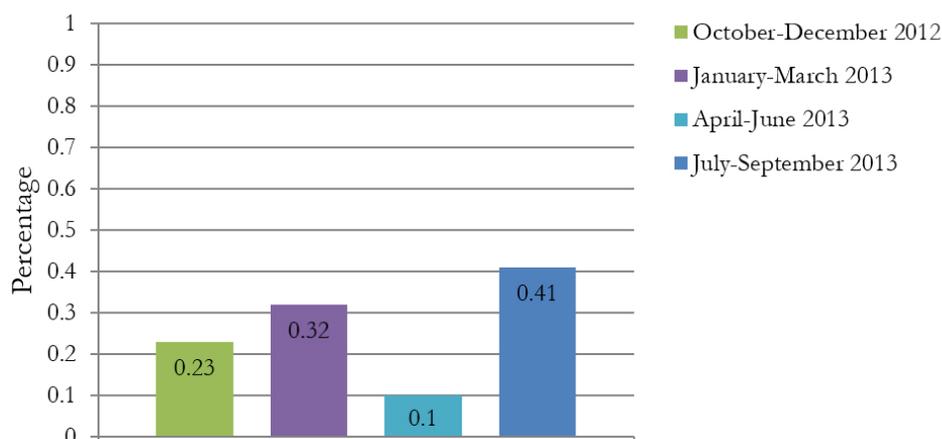
All trouble calls are documented and analyzed for problem trends. While many of the calls deal with clinical issues, those involving equipment problems are referred to Mike Vogel’s biomed staff. When a device is potentially at fault, PHS will put a substitute device in the home until troubleshooting can be completed. “We cover a large geographic region across Minnesota and Wisconsin,” says Long. “When needed we will travel to our patients, even at 2 am. Sometimes we have to get creative—maybe fly a ventilator back to replace it—but we go above and beyond to ensure that our patients can stay in their home community.”

Incident investigation is a specialty for the biomedical team. They typically do

## Using Research to Raise the Bar on Home Care

PHS has undertaken several research studies specific to home care and publishes all results on its website ([www.pediatrichomeservice.com/about-us-outcome.php](http://www.pediatrichomeservice.com/about-us-outcome.php)). Recent studies include one of central line-associated bloodstream infection rates (see graph). “We are trying to establish benchmarks in home care and share them. We are laying the groundwork for trying to raise the bar,” says Maynard. The company also publishes statistics on its own shipping accuracy, customer satisfaction, and after-hours call response rates. “We are very interested in improving outcomes of home care and trying to document prevalence of problems in the community,” he adds.

### Line Infections per 1000 Catheter Days Trending



The average percentage of central line-associated bloodstream infections in PHS patients during 2012 and 2013. With over 34,000 catheter days PHS saw an average of .265 line infections per throughout the last four quarters.

most of the troubleshooting once the equipment and accessories make it to the shop, but will go into homes if needed. All clinicians are trained to collect potentially faulty equipment and supplies and complete equipment problem reports. “We train the staff to get the whole picture and help us identify the problem,” says Vogel.

“We can also see the clinical charting piece of an incident report, which is very helpful in incident investigations,” Vogel says. They follow sentinel event protocol to investigate incidents in an unbiased way, and report incidents to manufacturers or industry watchdogs like the FDA via the MedWatch program as needed.

To help identify problems, PHS trends the numbers of complaints and repairs for each piece of equipment. They also actively monitor safety alerts from manufacturers and industry groups. When a piece of equipment is at fault, they test it, repair it, and verify that it’s ready to return to service. They track equipment problems v. user error to identify gaps in education. When needed, they conduct training to prevent or remediate user error. In one case, when a set of pulse oximeters would not alarm correctly, they pulled the entire product line.

“We look at device failure and user error data and feed that back to the manufacturers,” says Vogel. “We may also ask a

manufacturer to make a change to device design in the next revision.

## CHECKLIST – Equipment Problem Investigations

PHS does the following in the event of equipment problems:

- Brings replacement equipment to the home while the problem equipment is evaluated.
- Encourages families to provide their defective disposables for troubleshooting.
- Tracks product issues to identify any potential trends or patterns.
- Reports design flaws and consistent complaints to manufacturers and works with them to solve the problem.
- In event of user error, provides additional caregiver training, educational materials, or product alerts.
- Submits a MedWatch form to the FDA whenever a device or medication may have caused or contributed to complications with a patient or may have created the potential for complications.
- Tracks reported concerns by product and patient to help identify concerns with specific products and identify patient uses or treatments that may not be compatible with certain products.

## CONCLUSION

The delivery of healthcare in nontraditional settings is increasing rapidly as the population ages, people live longer with serious medical conditions, and hospitals strive to cut costs. Patients often prefer receiving care in the comfort of their own homes; this is doubly true for children with medical complexities and the parents who care for them. Yet, placing complex medical equipment in the home can be extraordinarily difficult.

PHS has built a successful business by focusing on that difficult task and working to innovate best practices in pediatric home healthcare. Their approaches to managing patient transitions, providing caregiver education, and managing home equipment offer a model that holds great promise for others seeking to serve the home care market.

In the end, PHS has been instrumental in allowing children with medical complexities to come home, where they belong, and stay home from the hospital. The parents from the PHS tracheostomy video say it best: “The most important thing to keep in mind is that your child is still a child,” says Rebecca, the patient’s mother. “It’s easy to get caught up in being their care coordinator, being their therapist, going to visits,

taking care of the trach, supplies. . . . Yes, she has these needs and she has these nurses, but I can still be her mom. My child’s home and they’re healthy. Home is where they need to be.”

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