Project Narrative

Causes and Impact from Delayed Hospital Discharges of Children with Medical Complexity on Pediatric Hospitals Days and Expenditures

Roy Maynard, MD[1]; Eric Christensen, PhD[1]; Abraham Jacob, MD, MHA[2]; Yves Ouellette, MD, PhD[3]; Heather Podgorski, MD[2], Sandra Potthoff, PhD[4]; Brenda Schiltz, MD[3]; Scott Schwantes, MD[5]; and William Wheeler, MD[1]

[1] Children's Hospital and Clinics of MN
[2] University of Minnesota Masonic Children's Hospital
[3]Mayo Clinic
[4]University of Minnesota School of Public Health
[5]Gillette Children's Specialty Healthcare

Aims

1. Children with medical complexity (CMC) have significant delays in home discharge due to lack of available extended hours of home care nursing. This project will define the scope and presumptive costs of the problem across multiple pediatric institutions.
2. Identify the causes and rates of unplanned hospital readmissions for CMC within 90 days of discharge.
3. Describe the cost of prolonged hospitalization relative to the reason for discharge delay, including but not limited to the cost of extended hours of home care nursing.

Hypotheses

1. The level of medical complexity in CMC is directly correlated with days of delayed discharge.
2. CMC residing in rural areas have significantly delayed discharges due to unavailability of nursing to staff patient at home.
3. Unplanned readmissions for CMC is inversely correlated with the amount of extended hours of home care nursing and directly correlated with an increased level of technology dependency.

Abstract

Although less than 1% of children are identified as medically complex, this increasing population consumes a disproportionate amount of health care resources. Up to 25% of pediatric hospital days and 40% of hospital charges are credited to children with medical complexity(CMC)[1]. Current estimates are that expenditures for CMC utilize one-third of health care dollars spent on children, and that 80% of those health care dollars is accounted for by hospitalization[2]. An increasing percentage of technology-dependent CMC require extended hours of home care nursing to facilitate a safe transition to home, minimize family burnout and costly readmissions. Although multiple factors may delay discharge of CMC following prolonged hospitalization, a paucity of data is available on the cause, frequency, and cost of continued hospitalization, both financially, and as a community resource. A shortage of home care nurses is reportedly a major cause of avoidable hospital days for this population and annually contributes to millions of dollars of health care expenditures in Minnesota (personal communication).

[1] Simons, TD, et al. Pediatrics. 2010 Oct;126(4):647-55. doi: 10.1542/peds.2009-3266. Epub 2010 Sep 20.
[2]Berry JG, et al. *The Landscape of Medical Care for Children with Medical Complexity.* Alexandria, VA; Overland Park, KS: Children's Hospital Association; 2013.

Importance of the Problem

Increasing numbers of technology-dependent children with medical complexity are surviving with chronic conditions and discharged back into Minnesota communities. Providing extended hours of home care nursing for the most complex of these patients facilitates safe transition to home, improves family quality of life for the child and siblings, and may minimize costly readmissions, family burnout, and need for respite care. Shortage of home care nurses to staff an ever

increasing population of CMC is a major contributor to increased length of hospital stay. There is a need for collaboration by pediatric centers in Minnesota to identify the magnitude of the problem among the different patient populations they serve. Reducing hospital utilization in this population is an important target for every pediatric center to decrease costs and increase the availability of pediatric beds, especially during high census periods. Information gathered from this study may help target causes that specifically lead to increased length of hospital stay by medically complex children. The purpose of this study is to analyze data collected by four participating children's hospital facilities (Children's Hospital and Clinics of Minnesota, University of Minnesota Masonic Children's Hospital, Mayo Clinic, Gillette Children's Specialty Healthcare) to better understand the causes and costs of discharge delays. Findings from this descriptive study will be presented to state policy makers for recommendations.

Project Design and Methods

This is a 12-month multi-institutional descriptive, medical chart review study involving discharge of children with medical complexity that have or qualify for extended hours of home care nursing. Patient recruitment will be from four participating children's hospital facilities (Children's Hospital and Clinics of MN, University of Minnesota Masonic Children's Hospital, Mayo Clinic, and Gillette Children's Specialty Healthcare). Data entry will be done by designated health care employees or research assistants directly involved in patient care. Study materials provided will define medically complex inclusion criteria, study two different groups (new versus existing complex patient), medically ready for discharge date, discharge diagnoses, and delayed discharge days. A modified discharge delay tool (previously published) will identify causes contributing to avoidable days. The number of avoidable hospital days specifically related to awaiting home care nursing to staff a patient will be captured. Causes of unplanned readmissions within 90 days of discharge will be tracked on enrolled patients from their respective hospitals.

Data collection

Information related to each study-eligible discharge will be entered via a high-security, encrypted website under the domain control of Data Intelligence Consultants, LLC. Designated individuals at each of the participating study sites will be issued a user ID and an access password that must be used for entry to the site. This access password will include a lead number to identify the study site.

Following entry authentication the designated individual will enter study-specific information for each discharge meeting established study criteria. Data entry is facilitated using LimeSurvey® (https://www.limesurvey.org/en/), an open-source survey application. Each access is date- and time-stamped for security and data validation purposes.

A patient identification number will be automatically assigned to new cases. Once opened, case records can be accessed only by the assigned patient identification number. Entered data do not include information that could be used to identify a patient. Only designated individuals will maintain an identification key linking the assigned study number to patient records.

Each identified data element will be designated as required for data entry. Screen presentation of data elements will include a menu of options, when possible, to minimize data entry errors; only a minimum number of data elements will require numeric entry. At periodic intervals data will be downloaded from the website and data validity checks made. Data issues identified for clarification will be submitted to the PI, who will communicate with the designated individuals at the study sites.

The level of medical complexity will be ascertained by the number of medical devices, interventions, and prescribed therapies patients receive at home. A previously published and modified discharge tool will be used to identify reasons for delayed discharge. Data collection will involve documenting avoidable days awaiting home care nursing to staff a patient at home. Secondary outcome measures will define the causes and rates of unplanned hospital readmissions within 90 days of discharge.

Data security

Data security procedures meet the standards of NIST 800-53, Revision 3, Annex 2 for moderate-impact organizations. The Standard Operating Procedures in effect include assignment of file passwords, data encryption, data back-up

protocols, hard-drive security, and storage protocols. In addition, access to study data is restricted to a SAS research programmer, a research scientist, and a data analyst assigned to the project.

Statistical analysis plan

Downloaded data will be converted to SAS v9.4 (SAS Institute, Cary, NC, USA). Multiple linear regression (MLR) techniques will be employed to estimate these measures controlling for multiple explanatory (independent) variables. MLR attempts to model the relationship between these explanatory variables and a dependent variable by fitting a linear equation to observed data. A dependent variable has been identified for the study: 1) Delayed Discharge Days, defined as the days from document of medically ready for discharge to actual discharge date. The independent variables include medical-complexity variables (home care nursing hours, medical equipment/therapies, diagnoses) and patient-specific variables (new vs. existing patient, sex, race, age at discharge, insurance status, geography, etc.).

Narrative for estimating savings associated with eliminating avoidable hospital days

We will estimate the savings from eliminating avoidable hospital days for CMC as the difference between hospital costs and home care costs. This requires estimates for the following:

- Distribution of avoidable hospital days for CMC
- Average cost per hospital day for CMC
- Distribution of home care hours per day for CMC
- Average cost of home care per hour
- Supply elasticity for home care services

The number of avoidable (delayed discharge) hospital days is the difference between the actual discharge date and the date the patient was medically ready for discharge. For costs per hospital day we will obtain estimates from the four children's hospitals involved in the study. From the data collection we will be able to determine the actual number of home care nursing hours per day that patients receive. We will also obtain estimates of home care nursing reimbursement rates for Medicaid and non-Medicaid patients from home care providers.

With this information we can compute the upper bound on potential savings from eliminating avoidable hospital days as the number of avoidable hospital days times the difference between hospital costs per day and home care costs per day. Note that this estimate is an upper bound in that it assumes avoidable hospital days can be completely eliminated at *current* home care nursing reimbursement rates. Realistically, the supply of home care nurses will only increase if reimbursement rates increase. Hence, eliminating avoidable hospital days will require an increase in the nursing reimbursement rate. We will use elasticity estimates for the supply of nurses as a proxy to estimate how much the reimbursement rate will need to increase to sufficiently increase the supply of home care to eliminate avoidable hospital days. Note that by increasing the home care reimbursement rate, the potential savings from eliminating avoidable hospital days will need to account for this rate increase for patients already receiving home care nursing, and not just for patients waiting for discharge to home care.

Because these savings estimates are based on multiple assumptions, we will conduct sensitivity analyses to determine how different the assumptions need to be before there are no savings. For example, we will test the sensitivity of the savings estimates by computing how much the home care reimbursement rate could increase before we reach the break-even point (i.e., hospital savings are exactly offset by increases in home care costs). We will check the sensitivity of the savings estimates when we increase the required number of home care nursing hours per day. We will also check the sensitivity of the results to the elasticity estimates for the supply of nurses. In this way, we will see if savings results are robust or hinge on the various supply and demand assumptions.

Patient Recruitment

Medically complex children (that meet criteria) will be identified by discharge planners/care coordinators from the four children's hospitals participating in the study. Patients will be enrolled as a new or existing patient based on strict criteria.* Existing patients may only be enrolled once; new patients may be enrolled twice—once as a new patient and once as an existing patient after a readmission. Enrollment goals include 100 new and 100 existing patients among the four children's hospitals over 12 months and meet all of the following inclusion criteria:

1. Patients under 21 years of age at time of discharge
2. Medically complex
    a. Multiple medications and/or therapies; three or more therapeutic interventions (medications, nutritional support, respiratory therapy, dialysis, airway clearance, oxygen, etc.)

   b. 2 or more subspecialists involved
   c. 2 or more chronic medical diagnoses expected to last at least 12 months or more
3. Technology dependent (one or more of the following)
   a. IV meds (TPN, milrinone drips, etc., thru central or PICC line)
   a. Tracheostomy
   b. Mechanical ventilation $\geq$ 8 hrs/day includes CPAP, BiPAP (invasive or noninvasive)
   c. Oxygen therapy
   d. Gastrostomy/jejunostomy (bolus or feeding pump)
   e. Airway clearance (includes vest, IPV, cough assist)
4. Extended hours of home care nursing care $\geq$ 8 hrs/week at discharge

*A **new** patient is defined as a newborn or a child not deemed medically complex prior to this hospitalization (e.g., newborn with complex medical problems being discharged for the first time, or a child previously not deemed medically complex whom after an accident, cardiac or respiratory arrest, surgery (cancer, cardiac, organ transplant, etc.) now meets inclusion criteria for medically complex).

An **existing** patient has been previously defined as being medically complex, has been at home with established home care nursing, and continues to meet inclusion criteria.

Main Outcome Measures

Percentage of enrolled CMC with prolonged hospitalization

New vs Existing medically complex child

Length of stay (days) till **medically ready for discharge**

Length of hospital stay in days beyond **medically ready for discharge**

Reason(s) for prolonged hospitalization per discharge tool

Level of patient complexity (tool based on number of therapies, medications, nursing hours patient qualified for)

Demographics

Age

Diagnosis

Chromosomal abnormality/syndrome

Race

Geographic

Insurance

Home care nursing hours/week

Cost/day of delayed discharge

Readmissions with 90 days