Measuring Nursing Outcomes, with a Focus on Inpatient Complications

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Slide 1: Title Slide
Measuring Nursing Outcomes, with a Focus on Inpatient Complications

Slide 2: Agenda
- Nursing Outcomes Measurement
- Risk Adjustment Models
- Nurse-sensitive measures
  - Areas with opportunity
  - Outcomes by Nursing Unit
  - Suggested Areas for Improvement
  - Tracking Measures over Time
- Electronic Data Collection Pros & Cons

Slide 3: Transition Slide
Nursing Outcomes Measurement

Slide 4: Outcomes Sensitive to Nursing Practice per Magnet Status Requirements
The American Nurse Credentialing Center (ANCC) has developed guidelines for hospitals to use when applying for ANCC Magnet Status. A Magnet Status hospital is one that has been recognized for excellence in nursing care. In addition to the indicators shown on this slide, there are additional ones that address other nursing issues such as nurse satisfaction, staffing ratios, retention, skill mix, etc. However, one area where hospitals tend to be challenged is in their ability to measure these outcomes sensitive to nursing practice. The ANCC requires that they be measured by nursing unit and tracked over time. It is not uncommon that nursing units track this information manually as (a) that tends to be their standard of practice, and (b) they are unaware that some of this information is available via electronic data.

The indicators with an asterisk (*) next to them are measures that can be obtained via electronic data.

Slide 5: Nursing Measures via Electronic Data Utilize Administrative Coding Data
All medical records are “coded” upon discharge to include all relevant diagnoses and procedures that the patient experienced during his/her hospitalization. These codes are used to determine patients’ DRG assignments and ultimately for reimbursement. They are also an excellent source of information of what happened to patients while they were hospitalized.
When coded as a secondary diagnosis (ie, not the reason for the patient’s admission),
certain diagnoses align with the outcomes sensitive to nursing practice: urinary tract
infection, pneumonia, GI hemorrhage, cardiac arrest, postoperative infection, DVT,
shock, sepsis, and pressure ulcers.

I have opted to display the high volume diagnoses in the top portion of this slide. You
will see in the bottom portion that there are many codes that represent some diagnoses
(eg, urinary infection, pneumonia, sepsis, shock, DVT). It is important to know that there
is a 1:many relationship for some of these diagnoses. A facility will need to make a
decision on what diagnosis code or codes to utilize when measuring these outcomes. The
Magnet Status requirements allow a facility to determine the best way for them to
measure their outcomes. Usually measuring the high volume diagnoses will capture the
majority of the patients who have experienced that outcome.

Slide 6: Transition Slide
Risk Adjustment Models

Slide 7: Risk Adjustment: Questions to Ask & Example Models
Many data sources and data analysis products report that their data is risk-adjusted.
Unfortunately, they often use different methods for risk adjustment. It is important as a
clinician and/or data analyst within a hospital setting to understand the risk-adjustment
model being utilized on your data.

A first question to ask is **what data is utilized?** You should understand what data is used
to calculate the risk adjustment. Is it just Medicare data? (This data is often older, and is
skewed for the over 65 population.) Is it a “national database”? Of what? How many
patient encounters are included? What is the data range?

Secondly, ask **what variable are utilized for risk adjustment?** Is it a model where just
a few key things are incorporated, such as age, gender, diagnoses, procedures? Are
outcomes included in the model? For example, a model that purports to provide risk-
adjusted LOS, but includes the patient’s LOS in the risk-adjustment just doesn’t make
sense.

Thirdly, ask **if the data is risk-adjusted at the patient level?** Many models that are
used routinely risk adjust at the DRG level (see the picture on APR-DRGs). The deficits
to a model that does this is that (1) DRGs were designed for financial purposes, so it is
difficult to apply clinical outcomes to a financial model, (2) patients are grouped together
based off of distinct outcomes, such as cost.

Therefore, even if patients have similar outcomes, (the dots for Patient 2 & Patient 3 in
the top bar) they are grouped separately due to an arbitrary cut-off. In other models, such
as the CareScience risk adjustment model, patients do not have an arbitrary cut off, and
Patients would be represented as having outcomes close to each other on a continuous
scale, versus falling into a specific “bucket”.
Slide 8: CareScience Patient Risk Assessment
In the CareScience model, which I would like for you to understand a bit before we look at the data later in the presentation, the risk-adjustment occurs at the patient level. Patients are risk adjusted based off of clinical, demographic, and referral/other variables. Each of these variables is weighed differently for their impact, by principal diagnosis, on each of 6 different outcomes: Mortality, Morbidity, Complications, LOS, Costs, & Charges.

This means that if 2 patients were admitted with identical risk-adjustment variables, but one patient was admitted with a principal diagnosis of Pneumonia, and the second was admitted with a principal diagnosis of CHF, the impact of the variables will be different – age may contribute a bigger risk for mortality in pneumonia than for CHF, for example.

In short, patients are not in buckets, but are adjusted individually based upon clinical variables.

Slide 9: Regression Model Concept
This graph is intended to represent the impact of one variable (age) on outcomes (complications). The individual dots represent distinct patient visits. Each patient’s age is multiplied by the beta value for age for this diagnosis (in this example the beta value is 0.074). NOTE: The beta values are determined through calibration of the CareScience customer data base (a national database of ~ 200 facilities that includes > 6 million patient encounters).

The calculation at the top of the slide is an example of how the patient’s risk for the outcome of complications is calculated. Each variable is multiplied by its beta value and the sum of all of these calculations equal’s the patient’s risk for that particular outcome.

This is a detailed concept that is usually taught in an hour, and I am presenting it in just a few minutes. You do not need to fully understand these details, just please understand that the data that you will be seeing later in this presentation was risk-adjusted utilizing patient level data (via a regression model).

Slide 10: Risk Adjustment (beta values) Process
This slide is hidden, but can be shown to further explain the beta values described in slide 9 if many questions arise.

Slide 11: CareScience Complications
We have two more slides on Risk Adjustment before we move into Nursing Outcomes Measures.

We discussed how we calculate a patient’s risk for complications, and now I want to review with you how we calculate the raw rate of complications within our analyses.
As you all know, patients are admitted to the hospital with many co-morbid conditions. For example, we know that many patients are admitted with CHF, and do not develop it only after admission to the hospital.

In order to accurately measure this concept, CareScience utilizes a probabilistic model to determine the percent of patients who developed a certain diagnosis after admission. The probability model pairs principal and secondary diagnoses and applies a probability to that pairing.

In this example, we see that a patient with a principal diagnosis of pneumonia and a secondary diagnosis of CHF has a 20% chance that the CHF developed after admission as a complication.

Slide 12: Probability Model: Distribution of Secondary Diagnoses by Complication vs. Comorbid Condition
This graph demonstrates the probabilistic model for a population of patients with pneumonia as a principal diagnosis.

If we looked only at secondary diagnoses, the rates of these “complications” would be much higher. By applying the probabilistic model, we get a more realistic picture of what is happening in this population. For example, of the 116 patients coded with A. Fib as a secondary diagnosis, CareScience probabilities predict that 64 (55%) were admitted with it as a comorbid condition, and that 52 (45%) developed it as a complication after admission.

This concept is important as we explore outcomes sensitive to Nursing Practice.

Slide 13: Transition Slide
Nursing Measures Outcomes Analysis

Slide 14: Outcome Comparison 3 Acute Facilities
Let’s imagine you are working in a multi-hospital system, and you are tasked in identifying (1) which facility has the most opportunity for improvement in their nursing outcomes measures, (2) What measure should the facility focus on, (3) what are the outcomes by nursing unit, and (4) what are some distinct initiatives they can take to improve outcomes?.

This graph depicts the facilities on the X-axis and the outcomes on the Y-Axis. The outcomes are measured in deviations from expected. The expected outcome is calculated via the risk-adjustment model, the raw outcome is what actually occurred, and the deviation is the difference between the two. The better outcomes are negative deviations, or lower than expected, the worse outcomes are positive deviations, or higher than expected.

Please note that this data is real hospital data that has been put through a rigorous blinding procedure to be utilized as a demo database.
In looking at the outcomes for these 3 facilities, we see that they all have opportunities for improvement. The asterisks represent statistical significance at the 90% confidence level. However, facility 1Acute has the biggest deviations from expected for complications, morbidity, and mortality. So, to answer the first question of our task, it is facility 1Acute is emerging as having more opportunity for improvement.

Slide 15: Nursing Outcomes Measure Comparison
But let’s drill down a little deeper. The task at hand was to look for opportunities for improvement for outcomes sensitive to nursing practice. Here I’ve compiled the rates of nursing sensitive measures occurring as a complication at the 3 different facilities.

Again we find that facility 1Acute has the higher rates, on the whole, of nursing sensitive measures, especially for UTI and pneumonia.

Slide 16: Quarterly Trends, Facility 1Acute
Filtering the data for just the 1Acute facility, I wanted to see what the rates of the nursing sensitive measures were over the last year. Only UTI and Pneumonia have been graphed as they were the high volume measures.

We see that the UTI rate is increasing, and that the pneumonia rate is fluctuating – it had taken a dip in Q3, but has been on the rise again in Q4.

Slide 17: Outcomes by Complication Facility 1Acute
Because of their high volume, pneumonia and UTI are emerging as the top areas of investigation, but we have been tasked to identify just one area for starters.

In order to help make that decision I wanted to look at the impact of pneumonia and UTI on outcomes.

What you see in this slide is that patients with pneumonia have worse outcomes (especially mortality) than the rest of the population. So, to answer the 2nd question, the facility of 1Acute should focus on the nursing sensitive measure of pneumonia.

Slide 18: Nursing Measures by Nursing Unit, Facility 1Acute
Thirdly, we were tasked to look at outcomes by nursing unit. In this slide I have plotted out the rates of all of the outcomes sensitive to nursing practice, and have graphed the high volume diagnoses of UTI & Pneumonia.

I present this information for two reasons: (1) I wanted to show you an example of how a facility can use electronic data to measure nursing outcomes by nursing unit. I would be happy to review what I did with anyone interested after the session – depending on how your data is set up you may be able to do this with pivot tables. I was lucky, as in the system I was using I was able to create this using standard front-end reporting.
The second reason of course is to help answer the questions we were tasked with – are their units that have a bigger issue with pneumonia than others? And of course, there are.

We see that 3 West, 4 West, Pediatrics (2 West), and CCU all have higher rates of pneumonia than the facility as a whole. In looking into this further I learned that 3 West is a neurology floor, 4 West is Oncology, and that Pediatrics is on 2 West. I don’t know the CCU floor.

It’s fascinating to me that all of these units are on the same floor, however – it is unclear if it is the patient population (doubtful due to the pediatrics mix), or if there is an environmental issue occurring.

In order to make recommendations for improvement, however, I needed to learn more about this population.

Slide 19: Transition Slide
Pneumonia Patients (Facility 1Acute) Data Drilldown

Slide 20: Complication Distribution, Pneumonia Patients
What happens to the pneumonia patients after admission, and what are their rates of outcomes sensitive to nursing practice?

We see that >25% of patients with pneumonia develop Acute Respirator failure as a complication, which likely is contributing to their mortality outcomes.

In addition, pneumonia patients have higher rates of nursing sensitive measures than the facility-wide population.

Slide 21: Comorbidity Distribution, Pneumonia Patients
I want to know more about this patient population. What are they being admitted with?

Like we can calculate rates of complications, we can also calculate (based off the probabilities) comorbidity rates of diseases/diagnoses patients are admitted with.

Here we see many “standard” comorbid conditions of a general medical population: CHF, HTN, COPD, Diabetes, etc. Interestingly, though, are the rates of cardio-pulmonary comorbid conditions – could the fact that a large proportion of patients have COPD, CHF, and/or bronchitis be related to the rate of Acute Respiratory Failure?

Slide 22: Population Characteristics, Pneumonia Patients
What else do I want to know about these patients?

How old are they? 68% are 65 years or older
How were they admitted? 69% were admitted via the ED, 30% via physician referral
How were they discharged? 37% went home with “self care”, 19% died.
I did a number of investigations into this data, and for purposes of presentation, I am going to focus on patient flow & placement.

In analyzing the data, I found that although a greater proportion of patients were admitted via the ED, the patients admitted via Physician referral had higher raw mortality rates and deviations than patients admitted via the ED. Though only 30% of patients were admitted by Physician referral, they contributed to 40% of the overall mortality rate.

In looking at inpatient flow, we see the highest raw mortality rate in those patients being admitted directly to ICU. It begs the question of whether or not the early intervention that occurs in the ED contributes to better outcomes?

Also, we found a large proportion of patients being transferred to and/or returning to the ICU during their stay.

7.4% of the entire population were transferred to ICU, and 3.4% returned to ICU after discharge.

Here one wonders whether there was appropriate triage for both admission to, and discharge from, the ICU.

And this analysis confirms a process breakdown in assessment and triage in my opinion.

Here we see that 46% of patients who transfer to a higher level of care or return to ICU, are transferred in 0-1 days from their previous site of care. Meaning, they should have been admitted straight to ICU, or had never been discharged from it.

In addition to diagnoses (complications, comorbidities), electronic data can also be used to investigate the procedures that patients had during their inpatient stay.

Here we see that most patients were on a ventilator (which correlates with the high rate of acute respiratory failure), as well as had other procedures from gastrostomy placement to cardioversion.
This is helpful in terms of getting a feel for the population, but what was the impact on outcomes?

Slide 27: Impact of Procedures on Mortality, Pneumonia Patients
We knew that this population had a higher than expected rate of mortality, so I was curious about the impact of procedures on mortality.

Here we see that patients who underwent cardioversion or were vented had higher rates of mortality than other procedures.

Slide 28: Timing of Ventilation & Cardioversion by Day of Stay, Pneumonia Patients
We can also derive timing of procedures via electronic data, as the dates of procedures (especially principal procedures) are recorded on the coding forms by medical records.

We see here in the graph that many patients are admitted quite ill and go straight on a ventilator, but almost 40% of patients are placed on the vent on or after day 3 of hospitalization. Tit is this patient population that intrigues me as well – what is happening later in the stay that the patient requires such an aggressive intervention?

The table below shows the dates for the individual patients who had cardioversion. In this facility only the dates of principal procedures are recorded, so I could only analyze a small portion of the data, which did reveal that 3 of the 5 patients who had a cardioversion as a principal procedure had it on the day of admission.

Of note, the ventilator population is represented in its entirety as I was able to use a resource charge code as a proxy for the ventilator procedure. All patients are charged for their initial first hour on a vent – I used the charge date for this code as a proxy for the procedure of being placed on the vent.

Slide 29: Transition Slide
Core Measure Compliance

OK, we’ve been through a lot of data. We’ve identified that facility 1Acute has a lot of opportunities, that pneumonia is the top opportunity in nursing sensitive measures, and that the floors 2West, 3 West, 4 West, and CCU have higher rates of pneumonia.

We’ve looked at the population itself and learned that most patients are over 65 years old and are admitted via the ED. However, patients admitted via physician referral have higher mortality rates.

And we’ve seen that acute respiratory failure is a high volume complication, that the population has a number of cardiopulmonary comorbid conditions (CHF, COPD), and that patients who undergo cardioversion or are put on a vent have higher rates of mortality.
Lastly, we’ve uncovered that there is a high proportion of patients who are being transferred (or bouncing back) to the ICU from a lower level of care within 0-1 days of arriving on the floor.

The last piece of our investigation involves resource utilization. How is the care being provided, and what is that impact on outcomes.

The JCAHO core measures are a good place to start when looking at resource utilization and core processes in general. Most hospitals collect this data, so it’s readily available for use.

What we are going to look at next is the facility level core measure data, and then break out some of the process measure compliance by nursing unit.

Slide 30: Oxygenation Assessment and Pneumococcal Screening
This facility is at or above the JCAHO observed rate for these two measures

Slide 31: Blood Cultures, Adult Smoking Cessation
This facility is at or above the JCAHO observed rate for Adult Smoking Cessation as of July 2004, but as been at or below the JCAHO observed rate for blood cultures.

Slide 32: Antibiotic Timing
This facility has been consistently below the JCAHO observed rate for antibiotic timing

Slide 33: Core Measure Compliance by Admission Unit, Antibiotic Timing (n>5)
This graph illustrates the core measure compliance for antibiotic timing for pneumonia patients for nursing units that cared for >5 patients in this measure group.

We see that 2 East and 4 West have the worst rates for antibiotic timing. As you recall, 4 West had a high volume of pneumonia as a complication.

Slide 34: Core Measure Compliance by Admission Unit, Blood Cultures (n>5)
This graph illustrates the core measure compliance for blood cultures on admission for pneumonia patients for nursing units that cared for >5 patients in this measure group.

Here we see that 2 East and Pediatrics have the worst rates for blood cultures on admission.

Pediatrics has a high rate of pneumonia. Upon investigation, I learned that 2 East is a cardiac floor. Therefore, it’s not surprising that they did not emerge as a floor with a high rate of pneumonia as a complication, nor is it surprising that their compliance with core measures isn’t up to speed as pneumonia is not really their specialty.

Slide 35: Transition Slide
Resource Utilization
OK, for this last part of our investigation, I wanted to correlate resource utilization with outcomes.

The next 4 slides illustrate how one can use electronic data to track resource utilization to identify opportunities, track best practice, and examine compliance of best practice by nursing unit.

Slide 36: Selected Resource Utilization, Pneumonia Patients
Here is an example of a standard report in the product that I utilized (CareScience Quality Manager™), but reflects information that should be available from a billing system.

What I’ve done is compile a list of clinically relevant resource charges to evaluate if patients are receiving the appropriate levels of care.

3 easy examples of this are:
  o Only 70% of pts have blood cultures. This correlates with the core measure data and appears low.
  o Patients are receiving on average 5.6 chest x-rays – this seems excessive
  o 83% of patients are receiving, on average 7.5 days of oxygen therapy – this, too, seems excessive (The average LOS for these patients was 7.6 days, so it appears that patients go on oxygen and just stay on it during their entire visit.)
  o And why are 29% of patients receiving blood?

Slide 37: Resource Utilization by Day
Looking at these resources in a little more detail we see that

  o The oxygen use does not taper by day at all
  o On any given day, about 40% of the population is getting a single-view CXR
  o The pulse oximetry use appears extremely low – are patients not getting it or is it just not being documented and/or charged.
  o Cephalosporins are the most utilized antibiotic

Remember, this information was all derived via electronic means. It’s helpful when presenting data to clinicians to have pulled together complete information for them to react to. Upon clinician review we may learn that there is a standard ordersheet that calls for daily CXRs and continuous oxygen – but having this information in a readable format for clinicians to react to helps move these investigations along.

Slide 38: Red Blood Cell Use by Nursing Unit, Pneumonia Patients
Here we see that CCU and 4East have the highest percentage of patients receiving blood, and also give the most units per patient.

One should consider unit specialties when interpreting this information – 4East is a surgical unit. Though, as you saw in the procedure distribution, this is not a very surgical group of patients.
Upon clinical review, there likely will be questions around other attributes of the patients who received blood (including who their physicians were).

Slide 39: Selected Resource Utilization by Nursing Unit, Pneumonia Patients
Lastly, I wanted to look at specific resource utilization by nursing unit – are there units that seem to have higher rates of certain interventions than others.

Here I have highlighted those measures that have exceeded what I felt, clinically, to be a reasonable threshold in terms of mean use and percent patients with use. If you were to do this at your facility, you would want to set your thresholds in conjunction with your clinicians.

4 East and CCU1 seem to have exceeded the most thresholds. But my take-away after all of this analysis isn’t so much that there is any one unit that is not performing well, but that there are definite facility-wide process breakdowns as evidenced by the broad red blocks in pulse oximetry, oxygen therapy and CXR. In addition, depending on how we cut the data, we had opportunities in 2 East, 4 West, Pediatrics, 4 East, and CCU. There wasn’t one particular unit that emerged, which often is the case whether looking at nursing units or specific physicians, it’s more common to find a process issue than “a bad apple”.

Slide 40: Suggested Areas for Improvement & Tracking Improvements Over Time Transition Slide

All of this data analysis is fun, and helps to tell a story, but that story is only as good as the interventions taken to make improvements. Many facilities get caught in the “analysis paralysis” phase, where they find it’s easier to keep going back to the data to ask questions than to draw a conclusion and implement change.

Any investigation that you undertake should include a summary of suggested actions – it usually isn’t at the first pass of data, as you’ve got to understand your population, but it does need to happen.

Slide 41: Summary of Pneumonia Findings with Suggested Areas for Improvement

- Only 30% of patients admitted via Physician referral, but they accounted for >40% of all mortality.
  - Evaluate Physician Referral methods. What is criteria to send patients to the ED?
  - Consider evaluation by Physician Service &/or pt. volume
- 46% of patients transferred to higher level of care or return to ICU within 0-1 days
  - Evaluate both ICU admission and discharge criteria
- Pneumonia rates higher on 3West (Neurology), 4West (Oncology), Pediatrics (2W), and CCU2
  - Consider targeted education on these units
  - Consider ID involvement to evaluate air quality/filtration
Resource Utilization requires further investigation
  - Duration Oxygenation & Pulse Ox utilization/documentation
  - Duration Ventilation
  - Single View CXR utilization (stat?) Why so many?
  - Blood Transfusion practices

Slide 42: Suggested Metrics for Pneumonia “Critical Few”
In any investigation, you want to limit your measures to the “critical few” that reflect the actions that you are taking. Like “analysis paralysis” it is easy to fall into the routine of measuring “everything”, but you truly just want to measure those items that represent the “critical few” interventions that you are making. I try to keep it to no more than 5, and I usually always have additional analysis on the list.

1. Pneumonia Rates by Unit
2. Admit Source Rates & Outcomes (especially mortality)
   - Physician Referral and ED Admits
3. Rates & Timing of ICU Transfers
4. Resource Utilization – align with Core Measures where possible
   - Blood Cultures
   - Antibiotic Timing
   - Oxygen duration
   - CXR Utilization
   - Pulse Oximetry Use
5. Potential Additional Analysis
   - Consider investigating impact of COPD as a comorbid condition on outcomes
     - Do these patients have worse outcomes? What is their rate of Acute Respiratory Failure?
   - Consider investigating the impact of age on outcomes
     - Do older patients have worse outcomes?

Slide 43: Administrative Data Pros & Cons
I have shown you today a complete example of how one can utilize administrative healthcare data (ideally with risk-adjustment applied) to conduct detailed analysis for opportunity identification and suggested interventions for improvement. However, I will be the first to also say that administrative data has its limitations. Almost any investigation will also require supplementation of data from other sources, such as a detailed chart review or a rapid-cycle PDCA data collection approach. However, Administrative Data is very complete and can be used effectively in these endeavors.

Types of Administrative Data
  - ICD9 Codes – Diagnosis & Procedure Codes
  - CPT-4 Codes – Procedure Codes
  - DRGs – Inpatient billing groups
  - CDM (Charge Description Master)

Pros
Easy Accessible
Consistent across facilities
Timeliness – it can be available prior to other sources

Cons

- Limitations to how much can be documented (e.g., 7 procedures, 10 diagnoses)
- Developed for billing purposes, not clinical analyses (e.g., DRGs with and without Cc)
- Timeliness – depending on your processes, it can also be delayed (e.g., 3-6 month lag time from the date of your investigation)