DIGITAL SURF
ONLINE STUDENT UNDERGRADUATE RESEARCH FESTIVAL
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Using Six Sigma to Improve Accounts Receivable at Shodair Children’s Hospital

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Six Sigma DMAIC Methodology

**Y (Key Business Process Output) = f (x_1, x_2, x_3, x_4, \ldots, x_n)**

- **Define**
- **Measure**
- **Analyze**
- **Improve**
- **Control**

- Charter defines our project & focus.
- Process Map identifies the Xs.
- KJ Analysis may highlight certain Xs.
- C&E reduces Xs by correlation to Y's.
- FMEA determines causes of X variable failures.
- Multi-vari statistic allow association of Y and key Xs.
- DOE design of experiments identify the Critical X’s and their sensitivity to the Y.
- Control Plans for Critical X’s: Sustain the Gains.

Optimized Process

\[ Y = f(x_7, x_{22}, x_{57}) \]
**Define: Charter**

**Process Definition:**
The work process in which the issues with Shodair's A/R is multi-faceted. The registration process is impacting the billing and claims process, which is then impacting Shodair's Accounts Receivable and their bottom line.

**Strategic Goal/Business Case:**
- Find a solution to outpatient Clinic A/R
- Aim for consistency
- Greater cash flow
- Unpaid debt
- Timely payments

**Problem Statement:**
- Numerous arising issues through A/R impacting negatively.
- Issues with billing and claims process
- Claims not properly implemented with hiring of new employees
- Too much man power needed to properly bill patients
Define: Process Map

**Step 1: Referral received**
- X: referral call, referral fax, referral doctors office, internal referral.
- Y: Insurance info, insurance authorized, Appointment is scheduled.

**Step 2: Physical appointment**
- X: Insurance is double checked, copay Deduction, added charges, HAR created.
- Y: Patient gets seen

**Step 3: Provider Charges Visit**
- X: Provider codes
- Y: Closed encounter

**Step 4: Close encounter with charge**
- X: Close with charge, 24 hours to charge, provider selects code
- Y: 5 Days to get charge pulled and coded, account closed with no activity

**Step 5: Route Accounting Code**
- X: Code is checked by medical records
- Y: Goes to A/R, pending A/R

**Step 6: Claim Generates**
- X: Account may close with no activity, late charges, work cue, fixed claim.
- Y: If correct, claim goes to clearing house.

**Step 7: Claim Adjudicate**
- X: Claim goes through clearing house
- Y: Payment, payment denial

**Step 8: Denial of Claim**
- X: Examination of benefits, lack of authorization, provider not enrolled
- Y: Bad debt, private pay, pay lower rate.

**Step 9: Balance is Brought to Zero**
- X: Patient pays, insurance pays, charity pays, charges are paid
- Y: Balance brought to zero
Our goal is to lower the accounts receivable days from 47 to 40.

The actual process spread is represented by 6 sigma.
# Measure

## Parent/Guardian Troubles (Financial/Mental)

<table>
<thead>
<tr>
<th>Parents Struggle to Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Single parents can’t pay</td>
</tr>
<tr>
<td>- Parents who are paying other child bills</td>
</tr>
<tr>
<td>- Weekly bills</td>
</tr>
<tr>
<td>- Adding bills of out of pocket payers</td>
</tr>
<tr>
<td>- Kids get put on medication, but insurance won’t cover so they come back and get new medication and that won’t work so they come back and get new medication that insurance will pay for (each time coming back the parents have to pay out of pocket)</td>
</tr>
<tr>
<td>- Families can’t pay Co-pay</td>
</tr>
<tr>
<td>- Families with no insurance</td>
</tr>
<tr>
<td>- No way to see if families are in good financial condition</td>
</tr>
<tr>
<td>- Lack of Clarity on whose responsible for bill in family</td>
</tr>
<tr>
<td>- High Deductable Plan</td>
</tr>
</tbody>
</table>

### Parents not in Mental Condition
- Parents who also have mental health issues
- Traumatized parents

### Chronic Illness/Repetitive Payments
- Repetition of appointments
- Number of diagnosis
- Number of weekly appointments

## 30 X-Variables

Into 3 Categories
Throughout the Measure section, we were able to bring the number of X-Variables down from 55 to 23.
For the FMEA, we can conclude that there are 8 top X factors. Those are: wrong guarantor, close account without encounter, close encounter without charge, charge not completed within timely window, not getting charge in at all, provider enrollment issues.
Analyze: One-Way ANOVA: Aging Days vs Different Providers

- ANOVA tests 3+ Levels of Discrete X, Continuous Y’s
- Null Hypothesis: All means are equal
- Alternative Hypothesis: Not all means are equal.

P-Value is 0, the null is rejected. There is a difference in means between providers in terms of aging days.

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**Method**

Null hypothesis: All means are equal
Alternative hypothesis: Not all means are equal
Significance level: \( \alpha = 0.05 \)
Rows unused: 18

Equal variances were assumed for the analysis.

**Factor Information**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Levels</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL Aging Days, BCBS, Medicaid MT, Medicare, Pacific Source</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Analysis of Variance**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Adj SS</th>
<th>Adj MS</th>
<th>F-Value</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>4</td>
<td>47963</td>
<td>11908</td>
<td>11.83</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>186</td>
<td>1998730</td>
<td>10133</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Model Summary**

<table>
<thead>
<tr>
<th></th>
<th>S</th>
<th>R-sq</th>
<th>R-sq(adj)</th>
<th>R-sq(pred)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100.661</td>
<td>2.33</td>
<td>2.14</td>
<td>1.54</td>
</tr>
</tbody>
</table>

**Means**

<table>
<thead>
<tr>
<th>Factor</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL Aging Days</td>
<td>1429</td>
<td>118.85</td>
<td>102.65</td>
<td>(113.62, 124.07)</td>
</tr>
<tr>
<td>BCBS</td>
<td>114</td>
<td>149.37</td>
<td>105.63</td>
<td>(130.88, 167.86)</td>
</tr>
<tr>
<td>Medicaid MT</td>
<td>434</td>
<td>89.38</td>
<td>91.91</td>
<td>(79.90, 98.85)</td>
</tr>
<tr>
<td>Medicare</td>
<td>3</td>
<td>226</td>
<td>182</td>
<td>(112, 340)</td>
</tr>
<tr>
<td>Pacific Source</td>
<td>7</td>
<td>93.1</td>
<td>92.1</td>
<td>(18.5, 157.8)</td>
</tr>
</tbody>
</table>

Pooled StDev = 100.661

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Interval Plot of ALL Aging Da, BCBS, ... 95% CI for the Mean
Improve

- Design of experiments determine effects of inputs of a process have on the final product.
- Identifies critical inputs of the process, brings understanding to that modifying the variables will have on process performance
- Examples of Possible DOE’s at Shodair:
  - Services covered vs services not covered
  - Encounters closed with charge vs encounters closed without charge
  - No charge at all vs charge late
Final control plans will determine the operating procedures and processes to control the vital X variables that drive the Y outcome in order to sustain the gains.

Who Will Be Monitoring?
Shodair Accounts Receivable & Financial Teams

What Will Be Monitored And/Or Changed?
- Increasing training and education for front desk employees, providers, billing personnel, and finance personnel.
- Review of Accounts Receivable Dollars.
- Review of Accounts Receivable Days.
- Measuring the success of the new improve measure, and comparing it to the overall goal of the Six Sigma process.
- Maintaining Shodair’s mission to help as many children as possible!
Y (Shodair A/R) = f (x₁, x₂, x₃, x₄ ..., xₙ)

We found...
- There are 9 steps in Shodair’s outpatient charging/billing process.
- Current A/R days are outside the preferred limits.
- 8 critical X variables are impacting Shodair’s A/R.
- There is no difference in A/R aging days between different insurance providers.

Y = f (X1: service not covered, X2: service covered at out of network rates, X3: wrong guarantor, X4: encounter not closed, X5: encounter closed w/o charge, X6: charge not submitted on time, X7: no charge at all, X8: provider enrollment issue)
Acknowledgements

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