International Ergonomics Association

Using SEIPS for Cost Justification of An Ergonomic Intervention in Endoscopy

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Project Overview

This project is based on an intervention implemented at hospitals and is extracted from a soon-to-be-published chapter: The Business Case for Ergonomics, in the book "*Ergonomics for Endoscopy: Optimal Preparation, Performance, and Recovery*", edited by Dr. Amandeep Shergill and published by Slack Incorporated. The aim of this project was to implement an intervention to reduce risk of Work-Related Musculoskeletal Disorders (WMSDs) for staff as well as improve safety and outcomes for patients during colonoscopy procedures. The role of the ergonomist in this project was to analyze the ergonomic intervention as a potential solution, assist with developing the cost-benefit analysis, and support implementation of the intervention. In addition to improved safety for patients, staff, and providers, the financial benefits are significant.

Project Description and Outcome

The unique patient handling duties of colonoscopies contribute to the high risk of work-related musculoskeletal disorders (WMSDs) among endoscopy personnel. Due to looping, a common complication that hinders scope advancement, endoscopy staff are frequently asked to apply manual pressure to the patient's abdomen during an exam. Forces required to successfully support the colon can exceed 100 pounds of force and staff typically maintain awkward postures while applying pressure for several minutes or more per procedure. If manual abdominal pressure fails to assist the endoscopist in advancing the scope, staff are then asked to reposition the patient from left lateral to supine, right lateral, or prone. The use of prolonged manual pressure at these high forces and repositioning patients would both be classified as both high-risk activities for WMSDs in endoscopy staff.

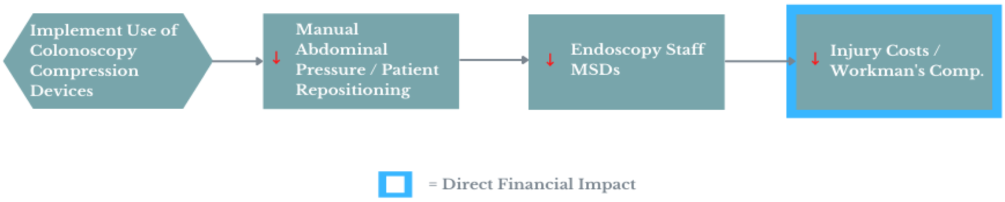
Colonoscopy compression devices (CCDs) are a new tool developed by ColoWrap, LLC (Durham, NC) to reduce looping during colonoscopy. A key benefit of these devices is a significant reduction in the need for endoscopy-staff applied manual abdominal pressure and subsequent patient repositioning. Recent studies have found that CCD use reduced the frequency of staff reported WMSD pain associated with supporting colonoscopy by 85%.

A community hospital that performs 2,500 colonoscopies per year has requested implementation of this ergonomic intervention. There are three endoscopists and eleven staff members (eight RNs, three technicians) that assist with procedures in the three rooms on the unit. One nurse was injured in the past year which she attributes to repeatedly applying manual abdominal pressure. The total cost of this injury for lost time, replacement staffing, surgery, and related medical expenses was $106,000.

For the cost justification analyses, it is assumed the intervention device is single-use and generally costs $150 per patient. The intervention will primarily be used for obese patients (BMI > 35) and patients with a known redundant colon, abdominal hernia, or multiple prior abdominal surgeries. This equates to approximately 33% of the overall patient population.

Cost-Benefit Analysis

Traditional ROI cost analyses focuses predominantly on injury cost savings and compares this to the cost of the intervention to assess return on investment. Traditional ROI approaches narrowly assess benefits and thus often fail to fully capture the value of ergonomic improvements. The factors that would likely be involved in a basic ROI assessment for this ergonomic intervention are:



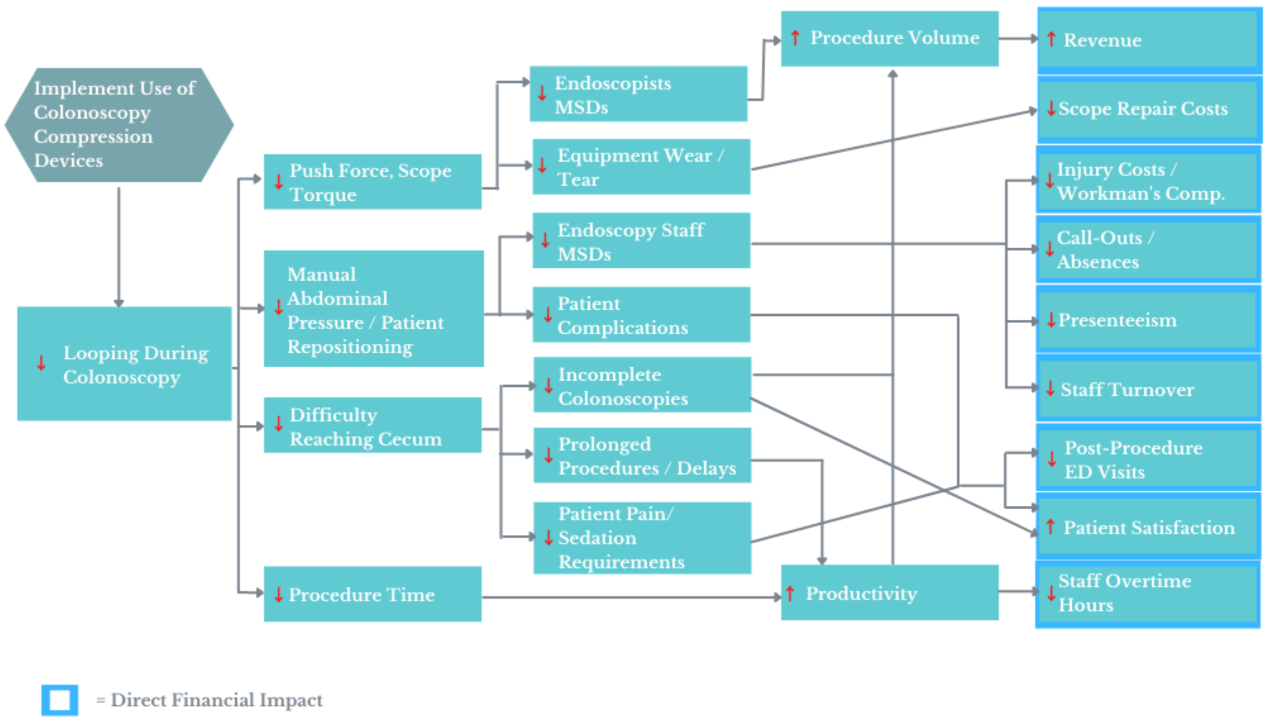
A cost justification using this ergonomic intervention adopting a traditional ROI approach is negative, communicating that the cost of the intervention will exceed the benefits. If this is the only analysis performed, it is possible that implementation of the ergonomic intervention at this hospital will not move forward. This scenario illustrates the challenge of cost-justification using ROI based exclusively on savings achieved through reduction in known injury expenses.

A basic ROI analysis comparing projected savings with intervention costs yields:

$$\text{ROI} = \frac{\text{Projected Savings (75\% of annual injury costs)} - \text{Cost of Intervention}}{\text{Cost of Intervention}}$$

$$\text{ROI} = \frac{\$79{,}500 - \$123{,}750}{\$123{,}750} = -35.7\%$$

Using a Systems Engineering Initiative for Patient Safety (SEIPS) model to quantify each downstream impact in terms of costs to the hospital and using estimates of the potential savings/benefits that would accrue to/against each impact due the CCD intervention is the preferred approach. Each of these issues leads to a multitude of downstream impacts that negatively affect patient and staff safety as well as the unit's business and financial performance. The relationship between impacts and outcomes for the CCD intervention is illustrated below.



Using a SEIPS model for cost justification assessment would consider how reducing looping might impact other key factors related to the unit's business objectives and incorporate these impacts into the cost justification analysis. As previously described, looping during colonoscopy is not benign. In addition to being a primary driver of WMSDs in endoscopy staff, looping is the primary cause of patient pain, prolonged insertion and anesthesia times, and failure to reach the cecum during colonoscopy. Looping also increases the push forces and torque and peak push forces of the right upper extremity are exerted when the endoscopist navigates a looping sigmoid colon. These high forces and torqueing that must be applied to the scope by endoscopists while performing the exam which can also be the cause of damaged scopes. Below is the cost justification analysis using a cost/benefit analysis (CBA) approach.

Cost Benefit Analysis and ROI for CCD Intervention

Benefits and Annual Projected Savings			
Result of Intervention	Benefit	Projected Savings	Pertinent References
Decreased scope force and torque	Reduced risk of endoscopist injuries	$68,052	Byun et al., 2008; Harvin, 2014; Liberman et al., 2005; Merrit Hawkins, 2019
	Reduced scope repair	$68,500	(from local data)
Decreased manual abdominal pressure and patient repositioning	Reduced risk of staff injuries	$79,500	(from local data)
	Reduced unplanned absences	$38,115	KPMG, 2017; Thinkhamrop et al., 2017; Ticharwa et al, 2019
	Reduced presenteeism	$2,019	Letvak, et al., 2012
	Reduced turnover	$48,000	Lockhart, 2020
	Reduced risk of patient complications	$54,266	Coser et al., 2018; Leffler, et al., 2010; Makker et al., 2021; Ranasinghe et al., 2016
Reduced Difficulty in Reaching Cecum	Reduced Number of Incomplete Colonoscopies	$94,500	Atkinson & Schmulewitz, 2009; Franco et al., 2017; Gawron et al., 2014; Pyenson et al., 2014
	Increased Patient Satisfaction	$22,680	Chartier et al., 2009
	Reduced Staff Overtime	$29,293	Crockett, 2016; KPMG, 2017; Occupational Employment and Wages, May 2020 Surgical Technologists;
Decreased length of cases	Reduced time per case	$84,000	Crockett et al., 2016; Hamade et al., 2019; Pyenson et al., 2014
Total Annual Benefits/Savings	$588,925		

Expenses and Annual Projected Costs		
Expense Type	Projected Costs	Pertinent References
Intervention Device	$123,750	(from manufacturer, ColoWrap, LLC)
Staff and Provider Training	$11,612	KPMG, 2017; Martin, 2021; Weltman, 2019; Occupational Employment and Wages, May 2020 Surgical Technologists
Total Annual Expenses and Costs	$135,362	

Cost Benefit & ROI	
Total projected benefits/savings: $588,925	Total projected expenses/costs: $135,362
Cost Benefit Ratio: 1:4.35 **ROI: 435%**	

Conclusion

In summary, the hospital projects a 50% reduction in right upper extremity injuries (among the hospitals' three endoscopists) which yields savings of $68,052. As scope repairs are typically very expensive, significant cost savings ($68,500) are realized through a relatively small reduction (20%) in equipment repair expenses. The hospital previously projected $79,500 in savings due to fewer staff injuries, yet did not account for unplanned absences, turnover, or medical errors caused by presenteeism which are all well-documented impacts associated with WRMSDs.

Estimated savings associated with each of these factors are $38,115; $48,000; and $2,019, respectively. Patient outcome related measures impacted by the intervention should also be assessed. Due to less looping and use of manual abdominal pressure, the hospital estimates a 20% reduction in the frequency of patient ED visits within 7 days following colonoscopy. This generates significant savings ($54,266) as the cost per ED visit is quite high ($6,783) and increasingly non-reimbursed.

The hospital also expects to complete a slightly greater percentage of colonoscopies (96.5% vs. 95%) due to minimization of looping. This too translates into significant savings ($94,500) as the cost per incomplete colonoscopy is estimated at $2,520. Because of improved outcomes, the hospital projects a slight increase (3%; from 94% to 97%) in the percentage of patients that are 'highly-satisfied' with their care. The value of this improvement is calculated to be $22,680.

The hospital estimates saving two minutes per colonoscopy in cases where the intervention is used, saving approximately 35 minutes per week. As a result, the hospital plans to add one extra procedure per week to the schedule, generating $84,000 in increased revenue. Finally, due to fewer prolonged (and incomplete) procedures that create schedule delays, the hospital projects a 15% reduction in staff overtime hours, equating to $29.292.75 in savings.

In aggregate, the hospital estimates a financial benefit of $588,924.75 due to the CCD intervention and estimates the total cost of the intervention to be $135,361.52. This generates a Cost-Benefit ratio of 1:4.35, meaning that for every $1.00 spent on the intervention, the hospital is getting a return of $4.35. This is a significant return on investment while also bettering the lives of patients, staff, and providers.

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