Published in final edited form as:

Congenit Heart Dis. 2010 ; 5(4): 374–381. doi:10.1111/j.1747-0803.2010.00434.x.

Resource Utilization After Introduction of a Standardized Clinical Assessment and Management Plan

Kevin G. Friedman, MD, Rahul H. Rathod, MD, Michael Farias, BS, Dionne Graham, PhD, Andrew J. Powell, MD, David R. Fulton, MD, Jane W. Newburger, MD, MPH, Steven D. Colan, MD, Kathy J. Jenkins, MD, MPH, and James E. Lock, MD

Department of Cardiology, Children's Hospital Boston and Department of Pediatrics, Harvard Medical School, Boston, Mass, USA

Abstract

Introduction—A Standardized Clinical Assessment and Management Plan (SCAMP) is a novel quality improvement initiative that standardizes the assessment and management of all patients who carry a predefined diagnosis. Based on periodic review of systemically collected data the SCAMP is designed to be modified to improve its own algorithm. One of the objectives of a SCAMP is to identify and reduce resource utilization and patient care costs.

Methods—We retrospectively reviewed resource utilization in the first 93 arterial switch operation (ASO) SCAMP patients and 186 age-matched control ASO patients. We compared diagnostic and laboratory testing obtained at the initial SCAMP clinic visit and control patient visits. To evaluate the effect of the SCAMP over time, the number of clinic visits per patient year and echocardiograms per patient year in historical control ASO patients were compared to the projected rates for ASO SCAMP participants.

Results—Cardiac magnetic resonance imaging (MRI), stress echocardiogram, and lipid profile utilization were higher in the initial SCAMP clinic visit group than in age-matched control patients. Total echocardiogram and lung scan usage were similar. Chest X-ray and exercise stress testing were obtained less in SCAMP patients. ASO SCAMP patients are projected to have 0.5 clinic visits and 0.5 echocardiograms per year. Historical control patients had more clinic visits (1.2 vs. 0.5 visits/patient year, $P < .01$) and a higher echocardiogram rate (0.92 vs. 0.5 echocardiograms/patient year, $P < .01$).

Conclusion—Implementation of a SCAMP may initially lead to increased resource utilization, but over time resource utilization is projected to decrease.

Keywords

Congenital Heart Disease; Tests; Practice Guidelines; Resource Utilization; Health Policy and Outcomes

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Corresponding Author: Kevin Friedman, MD, Department of Cardiology, Children's Hospital Boston, 300 Longwood Avenue, Farley 2, Boston, MA 02115, USA. Tel: (+1) 781-366-1803; Fax: (+1) 617-739-6282; kevin.friedman@cardio.chboston.org.

Conflict of interest: None.

Disclosures: None.

Introduction

Health care spending has consistently grown faster than the economy since the 1960s.^{1,2} The rise in the percentage of the Gross Domestic Product that is consumed by health care is alarming. According to the Centers for Medicare and Medicaid Services, health care spending is projected to exceed 20% of the US Gross Domestic Product by 2018. Understanding resource utilization and the impact of our interventions to reduce health care expenditures is critical to delivering more cost-effective care.

One approach to decreasing health care resource utilization and cost has been the implementation of Clinical Practice Guidelines (CPGs). CPGs have been shown to reduce practice variation, resource utilization, and costs in a broad range of medical conditions in the adult population.³⁻⁷ The use of CPGs in pediatrics has generally been limited to common conditions, such as otitis media and asthma, where convincing evidence-based guidelines can be created.⁸⁻¹⁰ A more important limitation of CPGs, as well as randomized controlled trials, is that they are frequently found to be unhelpful and even incorrect as time passes and new data become available.^{11,12} The Standardized Clinical Assessment and Management Plan (SCAMP) concept grew out of our attempts to standardize care through the development of CPGs. The lack of evidence on which to base guidelines, the lack of a data-driven standard of care for most conditions in our field, and the recognition that most CPGs lose validity rather quickly, limited our ability to develop and sustain CPGs. A SCAMP is a novel quality improvement initiative that standardizes the assessment and management of a relatively diverse patient population with a single diagnosis through a systematic and robust, but also selective, data collection process. Based on periodic review of the collected data, the SCAMP is designed to incorporate information feedback to facilitate ongoing progressive modification of the care delivery algorithm. A SCAMP has three primary goals. As with a CPG, a SCAMP aims to standardize care and reduce practice variation. As with a prospective study, a SCAMP will outline issues to be explored prospectively and ensure that data will be collected to permit subsequent effective analysis of those issues, and thus improve care. Finally and perhaps uniquely, a SCAMP is specifically designed to incorporate information feedback to allow progressive modification of the care delivery algorithm in order to improve patient care and optimize resource utilization.

A SCAMP is created by a committee of experienced, academic pediatric cardiologists, pediatric cardiothoracic surgeons, and pediatric cardiology nurses/nurse practitioners who, after a thorough literature review on the subject, construct an assessment and management plan through a consensus-based process. As part of the consensus-based process and to ensure reduction in practice variation, SCAMPs have been designed to be inclusive of testing in the initial cohort of patients in instances where significant practice variation existed and where committee members did not uniformly agree on the utility of a testing modality.

Currently, the Department of Cardiology at Children's Hospital Boston has six SCAMPs enrolling patients and an additional five SCAMPs that are in the development process (Table 1). Our department is a large academic practice with 70 staff pediatric cardiologists and approximately 30 pediatric cardiology fellows. To date, a total of 689 patients have been enrolled in the six finalized SCAMPs. The first SCAMP implemented in our department follows patients who have undergone the arterial switch operation (ASO). The ASO is the preferred surgery for patients with D-loop transposition of the great arteries (D-TGA) without significant pulmonary stenosis or with double outlet right ventricle (DORV).¹³⁻¹⁶ Since March 2009, we have attempted to enroll all patients who have undergone an ASO and returned for outpatient cardiology follow-up in a SCAMP, with a goal of following

these patients longitudinally from post-ASO hospital discharge through 18 years of age. This is an evaluation of resource utilization before and after initiation of a SCAMP, both at the initial SCAMP clinic visit and the projected resource utilization over years of longitudinal follow-up.

Methods

Based on consultation with the Children's Hospital Boston Committee on Clinical Investigation, a SCAMP is considered a quality improvement initiative and is therefore exempt from human studies research regulations. The Institutional Review Board for Clinical Research at Children's Hospital Boston approved the use of patient medical records for this retrospective study evaluating resource utilization after initiation of the ASO SCAMP. Participation in the SCAMP and deviations from the recommended testing and management algorithm are entirely at the attending physician's discretion. Deviations from the SCAMP are collected and analyzed as a component of the SCAMP initiative.

To evaluate initial resource utilization, we performed a retrospective 2:1 age-matched cohort study. The records of the first 93 patients enrolled in the ASO SCAMP and 186 age-matched control patient visits were reviewed. Patients were eligible for enrollment in the ASO SCAMP if they underwent an ASO for D-TGA or DORV within the first 3 weeks of age and were seen for follow-up in our outpatient division of cardiology. Patients were excluded if they underwent ASO as part of a double switch operation for correction of L-Transposition of the great arteries, were older than 18 years of age at the time of outpatient follow-up, or underwent ASO as a component of a more complex repair. Control patients were defined as patients who have undergone an ASO for D-TGA or DORV and were seen in our cardiology clinic within the last 5 years but prior to initiation of the ASO SCAMP. For each SCAMP patient, two control patients within the same 2 year age range were selected. The number of chest X-rays, echocardiograms, cardiac magnetic resonance imaging (MRI) studies (CMR), stress echocardiograms, nuclear perfusion scans, exercise stress tests, lung scans, and lipid profiles were compared between groups. Table 2 summarizes the testing recommended by the ASO SCAMP. For both groups, testing was considered associated with the index outpatient clinic visit if it occurred within the following intervals: within 1 week for chest X-ray, within 1 month for echocardiograms and lipid profiles, within 1 year for lung scans, nuclear perfusions studies, and stress echocardiograms, and within 2 years for CMR studies. The effect of SCAMP introduction on utilization of each testing modality was assessed using conditional logistic regression to control for the matched design of the study.

In addition, to evaluate the anticipated effect of the ASO SCAMP on resource utilization over time, we collected clinic visit and echocardiogram data for the last 60 ASO patients seen in the out-patient division of cardiology in the year prior to initiation of the ASO SCAMP. The number of clinic visits and echocardiograms per patient year, between age 1 and most recent follow-up, were compared to the projected number of clinic visits and echocardiograms per patient year for ASO SCAMP participants. A second analysis was performed excluding patients who had a considerably higher or lower than anticipated visit and echocardiogram rates. This was done in order to account for patients who have been lost to follow-up, are primarily followed at an outside institution, or who have had unusually complicated courses necessitating increased surveillance. The outliers were defined as patients having a clinic visit rate or echocardiogram rate greater than 2 per year or less than 0.3 per year. The chi-square test for a Poisson distribution determined statistical significance. Clinic visits and echocardiograms prior to 1 year of age were excluded from the data collection because of wide variability in the neonatal and postoperative course. Additionally, the ASO SCAMP begins at post-ASO hospital discharge and therefore does not include the pre- and initial postoperative course.

Results

In the first 9 months of ASO SCAMP enrollment, 86 SCAMP eligible patients were seen in our cardiology clinic and enrolled. The age range of enrolled patients was 3 weeks to 18 years (Table 3). Resource utilization at the initial SCAMP clinic visit was compared to age-matched historical control patient visits for ASO patients seen in clinic prior to ASO SCAMP initiation (Table 4). Echocardiograms were the most frequently ordered testing modality in both groups by a wide margin. Echocardiogram utilization was nearly identical in the two groups. CMR ($P = .01$), nuclear perfusion scans/stress echocardiogram ($P = .02$), and lipid profile utilization rates were higher in the SCAMP patients. Lung scan usage was similar between groups. Chest x-ray ($P = .03$) and exercise stress testing utilization rates were lower in the SCAMP patients.

The most significant increases in utilization were in CMR studies, stress echocardiograms, and lipid testing. The SCAMP protocol recommends a CMR and either a stress echocardiogram or nuclear perfusion scan (if echocardiographic windows are poor) for all patients at 12 years of age or for any patient 12–18 years of age who has not had these studies previously, in order to evaluate for subclinical coronary artery disease (Table 2). No control or SCAMP patient under 12 years of age had a CMR. A total of 23 patients between age 12 and 18 have been enrolled in the ASO SCAMP. Of these 23, 15 (65.2%) had a CMR in conjunction with the initial SCAMP visit. Of the 46 historical control patients aged 12–18, 11 (23.9%) had a CMR as part of the reference clinic visit. Stress echocardiograms were performed in 4 of 9 (44.4%) of SCAMPs patients at age 12. Two additional patients underwent stress echocardiography at interval visits at age greater than 12. No nuclear perfusion studies were performed in the SCAMPs patients. One control patient underwent stress echocardiogram and one control patient had a nuclear perfusion study. For similar reasons, the SCAMP recommends nonfasting lipid testing at ages 6, 12, and 18 or at the initial SCAMP visit if the patient is greater than 6 years of age and lipid testing has not been done previously. Eight of 30 (26.7%) SCAMPs patients seen at age 6, 12, or 18 had lipid testing performed. Seven additional patients had lipid testing at clinic visits at age 8, 10, 14, or 16. No control patients had lipid testing performed within 1 month of the index clinic visit. Seventeen control patients underwent exercise stress testing, while no SCAMP patients had exercise stress testing.

Follow-up for ASO SCAMP patients is currently limited to 9 months. In this time period, the vast majority of patients (94.3%) enrolled in the ASO SCAMP have had only a single clinic visit. Thus, we are unable to prospectively evaluate changes over time in resource utilization associated with SCAMPs initiation. For this reason, we compared the projected number of clinic visits (Table 5) and echocardiograms (Table 6) in SCAMP-enrolled patients to those of historical controls. The ASO SCAMP recommends a clinic visit and echocardiogram every other year from ages 1 to 18 years, thus ASO SCAMP participants are projected to have 0.5 echocardiograms per patient year and 0.5 clinic visits per patient year after age 1. Historical control ASO patients had a significantly higher clinic visit rate of 1.21 visits per patient year ($P < .01$) and a higher echocardiogram rate of 0.92 echocardiograms per patient year ($P < .01$).

When outliers were excluded from the analysis, the clinic visit rate was 1.3 clinic visits per patient year and the echocardiogram rate was 0.77 echocardiograms per patient year, both of which were considerably higher than the projected rates for SCAMP participants ($P < .01$).

Discussion

Implementation of CPGs in pediatric cardiology and many fields of medicine has been limited. Many would argue their usage will and should continue to be limited. One argument against CPGs is that there is insufficient evidence to make definitive practice recommendations for many conditions. Some would even assert that “best practice” CPGs, even in well-studied fields, are so frequently shown to be incorrect at a later date that their use should be curtailed.^{11,12} Another limitation of CPGs is that they are not designed to collect relevant data that allow their own guidelines to be revised and improved. Despite these limitations, CPGs have been used with some success in the immediate postoperative management of selected congenital heart lesions reducing resource utilization, duration of hospitalization, and cost of postoperative care.^{17–19} However, CPGs designed for longitudinal follow-up of children with congenital heart disease are sparse and do not include class indications or levels of evidence.²⁰ Not surprisingly in a field caring for rare and diverse lesions, pediatric cardiology is characterized by wide institutional and individual practice variation.^{21–23} The quality improvement literature has consistently shown that reducing practice variation leads to better patient outcomes, decreased patient care costs and improved efficiency.^{24–26} The three goals of the SCAMP initiative are to reduce practice variation, to optimize resource utilization, and to improve patient care. This is our preliminary evaluation of resource utilization after SCAMP implementation.

This study suggests that SCAMP implementation may lead to an initial increase in utilization of some testing modalities, particularly advanced imaging studies. The increase in CMR studies, stress echocardiograms, and lipid testing is not surprising and is directly attributable to SCAMP recommendations. This increase in utilization was anticipated and is largely a reflection of the premise that testing should be more inclusive in the initial cohort of SCAMP patients, particularly in areas where there is significant practice variability and the utility of a modality has not been definitively established. This approach of front-loading testing in the initial cohort will allow us to reduce practice variation, to determine the utility and cost-effectiveness of specific test modalities, and then to optimize resource utilization by reducing or altogether eliminating low yield or unnecessary testing. For example, the ASO SCAMP algorithm recommends a CMR and stress echocardiogram for all patients at age 12 or at any interval visit between the ages of 12 and 18 if not previously done. Though this leads to an initial increase in resource utilization, these advanced testing modalities may or may not offer clinical advantages over echocardiography alone. In ASO patients, late coronary complications are one of the major postoperative concerns.^{27–32} At present, the incidence, risk factors, and severity of coronary events in patients who have undergone ASO is not entirely known. The sensitivity and specificity of various imaging modalities for ischemia in this patient population is also not known. Prior to SCAMP implementation, there was wide variation within our department in the utilization of CMR, exercise stress testing, stress echocardiography, nuclear perfusion scans, and lipid testing. The data obtained from this SCAMP will allow us to explore the utility and yield of various testing modalities for coronary artery disease in this patient population. CMR is thought to allow improved evaluation of several of the most common complications seen in patients after the ASO, including coronary artery abnormalities, branch pulmonary artery stenosis, aortic regurgitation, and aortic root dilation.^{33–37} In adults with atherosclerotic coronary disease, stress echocardiography and stress nuclear perfusion scans allow for improved detection of ischemic disease over conventional exercise testing or echocardiography.^{38,39} ASO patients may be at increased risk of coronary ischemia related to premature atherosclerotic disease. The role of hypercholesterolemia and atherosclerotic disease in coronary artery disease in this population is not known. By obtaining these studies in the entire cohort, at specified intervals, we expect to learn if these testing modalities improve care in all or a subset of patients. A plausible outcome of this SCAMP is that some, but not all, of the increased

testing will help to identify subclinical coronary ischemia and other complications earlier. In this example, if the clinical utility of CMR or stress echocardiography for the detection of subclinical coronary disease is sufficiently low, then one or both will be removed from the algorithm. Similarly, the use of advanced testing modalities at infrequent but scheduled intervals, may or may not allow clinicians to be comfortable with decreasing their more routine surveillance, in this case clinic visits and echocardiograms, and may lead to reduction in overall resource utilization and cost over years of longitudinal follow-up. It will take years of follow-up to prospectively determine the influence of the ASO SCAMP on earlier recognition of pathology and subsequent effects on hospitalizations, emergency visits, type and frequency of reinterventions, and ultimately on patient care costs.

We hypothesize that the initial increase in testing utilization will be superseded by a decrease in testing over longitudinal follow-up as resource utilization is optimized. Echocardiograms account for a large portion of resource utilization in this patient population. We have shown that the initial resource investment and the use of a structured protocol are predicted to decrease the frequency of clinic visits and serial follow-up studies, in this case echocardiograms, which are estimated to decrease by 31–45%. Obviously, we will watch closely for any signs of delay in diagnosis. If this were to occur, the SCAMP would be modified to increase surveillance in subgroups at risk. Our expectation is that over time, most SCAMPs will be modified to reduce resource utilization as advanced testing modalities that are found to be low yield or redundant are eliminated from the care delivery algorithm. This type of modification will increase efficiency and likely further decrease resource utilization but will take several years of follow-up to evaluate.

An additional factor that may contribute to the higher utilization of advanced testing modalities in the SCAMP patients is a general trend toward increased availability and usage of CMR and stress echocardiography over the last 10 years.^{40,41} This may have led to an overestimate of the initial increase in utilization of these testing modalities associated with SCAMP implementation.

Limitations of this study include those inherent in the use of a retrospective control group. Although all SCAMPs have been built on similar principles, changes in resource utilization and patient care costs with implementation of each individual SCAMP will be different. We have assumed 100% adherence to the SCAMP to obtain the projected number of clinic visits and echocardiograms. For a variety of reasons, adherence to a SCAMP will never be total. Overall adherence to the ASO SCAMP has been approximately 70%, but adherence has varied significantly for individual testing modalities: 95% for echocardiograms, but 40% for lipid testing. If adherence were higher, we may have seen a greater increase in utilization of advanced testing modalities and lipid testing. The long-term effect of nonadherence on resource utilization is difficult to predict and likely will lead to testing patterns more closely resembling testing in historical control patients. Reasons for nonadherence vary and may include patient-specific clinical data, family/patient preference, physician preference, or that the patient had the recommended testing at a relatively recent pre-SCAMP visit. In this analysis we did not evaluate the reasons for nonadherence. Deviations from the SCAMP, reasons for deviations, and the effect of deviations on resource utilization, patient care costs, and outcomes are being collected and evaluated as part of the SCAMP initiative.

Conclusions

In summary, we have begun a program-wide initiative using an innovative quality improvement tool in an attempt to standardize care, improve outcomes, and reduce resource utilization across a broad range of patients. The preliminary data described here support the hypothesis that implementation of a standardized clinical assessment and management plan

may initially increase resource utilization, but over time is projected to lead to a reduction in resource utilization.

Acknowledgments

Financial support: Supported by grants from the Randi and Perri Hinden Fund and The Boston Children's Heart Foundation.

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Table 1

Current SCAMPs at CHB, Department of Cardiology

SCAMP	Date of SCAMP Initiation	Number of Patients
Arterial switch operation	03/22/09	149
Hypertrophic cardiomyopathy	04/05/09	124
Dilated aorta	08/30/09	274
Aortic stenosis	09/05/09	37
Aortic regurgitation	10/18/09	32
Interstage single ventricle	11/22/09	6
HLHS with MS/AA	In development	—
Chest pain	In development	—
Small PDA	In development	—
Syncope	In development	—
Dyslipidemia	In development	—

* Enrollment numbers as of 1/20/10.

SCAMPs, Standardized Clinical Assessment and Management Plans; CHB, Children's Hospital Boston; HLHS, hypoplastic left heart syndrome; MS/AA, mitral stenosis aortic atresia; PDA, patent ductus arteriosus.

Table 2

Summary of ASO SCAMP Testing Recommendations

Clinic Visit	Outpatient Visit	CXR	Lipid Profile	ECHO	CMR	Stress ECHO or Nuclear Perfusion Scan [‡]
1–3 weeks postrepair (0–4 weeks)	x	x				
6–12 weeks postrepair (4–12 weeks)	x					
6 months postrepair (4–9 months)	x			x (sedated)		
12 months postrepair (9–18 months)	x					
2 years of age (18 months–2 years)	x			x		
4 years of age (3–4 years)	x			x		
6 years of age (5–6 years)	x		x	x		
8 years of age (7–8 years)	x			x		
10 years of age (9–10 years old)	x			x		
12 years of age (11–12 years old)	x		x	x		[‡]
14 years of age (13–14 years old)	x			x		
16 years of age (15–16 years old)	x			x		
18 years of age (17–18 years old)	x		x	x		[‡]

x Indicates testing is recommended at that visit.

[‡] Stress echocardiogram (ECHO) recommended. Nuclear perfusion scan is recommended in place of stress echocardiogram if acoustic windows are poor. ASO, arterial switch operation; SCAMP, Standardized Clinical Assessment and Management Plan; CMR, cardiac MRI; CXR, chest X-ray.

Table 3**Age Distribution of ASO Patients at Index Clinic Visit**

Age at Clinic Visit	SCAMP n = 93	Controls n = 186
1–3 weeks postrepair (0–4 weeks)	4	8
6–12 weeks postrepair (4–12 weeks)	7	14
6 months postrepair (4–9 months)	9	18
12 months postrepair (9–18 months)	9	18
2 years of age (18 months–2 years old)	7	14
4 years of age (3–4 years old)	7	14
6 years of age (5–6 years old)	17	34
8 years of age (7–8 years old)	3	6
10 years of age (9–10 years old)	7	14
12 years of age (11–12 years old)	9	18
14 years of age (13–14 years old)	6	12
16 years of age (15–16 years old)	4	8
18 years of age (17–18 years old)	4	8

ASO, arterial switch operation; SCAMP, Standardized Clinical Assessment and Management Plan.

Table 4

Resource Utilization at Initial Clinic Visit Before and After ASO SCAMP Implementation

	ASO SCAMP visits n = 93	ASO control visits n = 186	P value
Echocardiograms	64 (68.8%)	130 (69.9%)	.82
Cardiac MRI	15 (16.1%)	6 (3.2%)	.01
Stress echo/nuclear perfusion scans	6 (16.1%)	2 (1.1%)	.02
Lipid profiles	15 (16.1%)	0	—
Lung scans	5 (5.4%)	8 (4.3%)	.70
Chest radiographs	1 (1.1%)	16 (8.6%)	.03
Exercise stress test	0	17 (9.1%)	—

ASO, arterial switch operation; SCAMP, Standardized Clinical Assessment and Management Plan.

Table 5

Projected Effect of ASO SCAMP on Frequency of Clinic Visits

	Control ASO patients n = 60	Control ASO patients excluding outliers n = 54
Follow-up (patient years)	496	414
Total number of clinic visits (per patient year)	603 (1.21)	540 (1.3)
Projected visits for SCAMPs patients (per patient year)	248 (0.5)	207 (0.5)
<i>P</i> value	<.01	<.01

ASO, arterial switch operation; SCAMP, Standardized Clinical Assessment and Management Plan.

Table 6

Projected Effect of ASO SCAMP on Frequency of Echocardiograms

	Control ASO patients n = 60	Control ASO patients excluding outliers n = 52
Follow-up (patient years)	496	414
Total echocardiograms (per patient year)	455 (0.92)	340 (0.77)
Projected echocardiograms for SCAMPs patients (per patient year)	248 (0.5)	220 (0.5)
<i>P</i> value	<.01	<.01

ASO, arterial switch operation; SCAMPs, Standardized Clinical Assessment and Management Plans.