

Critical Pathways for Postoperative Care After Simple Congenital Heart Surgery

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Abstract

Objective: To evaluate the clinical, financial, and parent/patient satisfaction impact of critical pathways on the postoperative care of pediatric cardiothoracic patients with simple congenital heart lesions.

Study Design: Critical pathways were developed by pediatric intensive care nurses and implemented under the direction of pediatric cardiothoracic surgeons.

Patients and Methods: Critical pathways were used during a 12-month study on 46 postoperative patients with simple repair of atrial septal defect (ASD), coarctation of the aorta (CoA), and patent ductus arteriosus (PDA). Using the study criteria, a control group of 58 patients was chosen from 1993. Prospective and control group data collected included postoperative intubation time, total laboratory tests, arterial blood gas utilization, morphine utilization, time in the pediatric intensive care unit, total hospital stay, total hospital charges, total hospital cost, and complications. Variances from the critical pathway and satisfaction data were also recorded for study patients.

Results: Resource utilization was reduced after implementation of critical pathways. Significant reductions were seen in total hours in the pediatric intensive care unit, total number of laboratory tests, postoperative intubation times, arterial blood gas utilization, morphine utilization, length of hospitalization (ASD, 4.9 to 3.1 days; CoA, 5.2 to 3.2 days; and PDA, 4.1 to 1.4 days; all $P < 0.05$), total hospital charges (ASD, \$16,633 to \$13,627; CoA, \$14,292 to

\$8319; and PDA, \$8249 to \$4216; all $P < 0.05$), and total hospital costs. There was no increase in respiratory complications or other complications. Patients and families were generally satisfied with their hospital experience, including analgesia and length of hospitalization.

Conclusion: Implementation of critical pathways reduced resource utilization and costs after repair of three simple congenital heart lesions, without obvious complications or patient dissatisfaction.

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Critical pathways, which are also known as care maps, fast tracks, clinical pathways, and care process models, have been used for several years to ensure that postoperative care of cardiothoracic surgical patients is consistent and cost effective.¹⁻⁷ Recently, there have been several applications of critical pathways for the postoperative care of congenital heart disease,⁸⁻¹¹ but the effects on patient satisfaction, laboratory and medication utilization, and respiratory complications have not been reported in depth. We developed and implemented critical pathways for the postoperative care of pediatric patients with simple atrial septal defect (ASD), coarctation of the aorta (CoA), and patent ductus arteriosus (PDA). We report our experience with these protocols, including patient and family satisfaction information. This project was undertaken in response to environmental and market concerns as third party payers sought lower cost providers who could maintain high quality care.

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... METHODS ...

Development

A Continuous Quality Improvement (CQI) team, comprised of a team leader, facilitator, and several pediatric intensive care nurses, developed 3 critical

pathways for simple congenital heart lesions under the guidance of pediatric cardiothoracic surgeons. Standard postoperative orders were written to accompany the critical pathways. Due to the focused team effort, critical pathway design, staff training, and implementation were accomplished in 4 months.

Pathway Description

Critical pathways consist of the detailed plan of care that specifies the use and timing of diagnostic tests and procedures according to patients' postoperative progression. Our pathways were designed around the achievement of 6 goals: (1) early extubation; (2) avoidance of a prolonged pediatric intensive care unit (PICU) stay; (3) pain control without excessive use of narcotics; (4) early ambulation; (5) early alimentation; and (6) discharge planning and teaching. Extubation was achieved in the operating room or as soon as possible in the PICU.¹²⁻¹⁴ Postoperative monitoring was standardized, and time in the PICU was minimized. (For example, PDA patients are currently stabilized in the recovery room and sent directly to the general medical/surgical ward, bypassing the PICU altogether.) Pain control was achieved by a prophylactic regimen; acetaminophen suppositories (10 to 15 mg/kg) were given immediately on arrival from the operating room and then every 4 hours. Ketorolac tromethamine (0.5 to 1 mg/kg) was started when the operative bleeding was under control. When medication was tolerated by mouth, ibuprofen was begun (10 mg/kg, every 6 hours). Morphine sulfate (0.1 mg/kg) was used as necessary for pain control. Continuous intercostal local nerve blocks were placed for patients with coarctations and PDAs.¹⁵ Children were up in bed or sitting 6 to 12 hours after surgery, and ambulated on postoperative day 1. Clear liquids were permitted 6 hours after extubation, and most children were eating on postoperative day 1. Finally, patients and their families were oriented to the critical pathway before surgery, and daily goals were posted at the bedside so parents knew what to expect after surgery.¹⁶

Discharge teaching was begun on day 1 of the hospitalization. Parents were given detailed discharge instructions and printed materials at the time of discharge. Patients were called 3 days post-discharge for a routine follow-up interview, which was administered with the satisfaction survey. Questions included the following: "What is the appearance of the wound?", "Does the patient have a fever?", "How is the patient's appetite and diet?", and "Is the child in pain?" A routine follow-up office visit was scheduled with the surgeon 2 weeks

after the operation. Children judged at risk for complications such as pneumothorax or pericardial effusion were seen 1 week postoperation for evaluation and a chest film.

Standard orders were used to implement the critical pathways. Variances, defined as any deviation from the critical pathway, were recorded but only to change and improve the pathway. In no instance were punitive measures used if the pathways were not followed; caretakers were asked to explain the variation so the pathway could be adjusted if needed.

Patient Population

Critical pathways were used for patients undergoing repair of ASD, CoA, or PDA beginning in March 1995. In this article, we report on our 12-month experience from March 1995 to March 1996. When the surgeons conceived of critical pathways as a tool to decrease variation and lower costs of the postoperative care of simple cardiothoracic patients, the intent was to change practice. Our facility does not require institutional review board (IRB) approval for changes in practice, and, therefore, the IRB was not contacted before the program described in this article was initiated.

A control group for each diagnosis was chosen from 1993 by reviewing charts to determine eligibility, applying the same study inclusion criteria as were applied to the critical pathway patients. Study and control group patients were admitted to the hospital for repair of simple, single cardiac lesions. Age criteria were older than 3 months for CoA patients and older than 1 month for PDA patients. Comparisons within each diagnosis between the control and study groups included arterial blood gas and other laboratory utilization, morphine and other narcotic utilization, postoperative intubation time, time in the PICU, respiratory complications and other complications, readmissions, hospital stay, hospital costs, and total hospital charges. Respiratory complications were defined as pneumonia, atelectasis, pleural effusions, reintubation, and chest tube reinsertion.

Data Collection

Standard orders and a photocopy of the critical pathway accompanied patients from the operating room. Bedside nurses noted order variations directly on the critical pathways, which were then collected and tabulated after patients' discharges. Data on laboratory utilization, pain medications, oxygen utilization, and respiratory complications were col-

lected by charge nurses each shift. If a data variable or critical pathway/ variance sheet was incomplete, the chart was reviewed. Control group data were obtained through retrospective chart review and the computerized charging and billing system. Financial data were obtained through the hospital's computerized charging and billing system. We report both hospital charges and costs. To determine costs, at least 90% of all revenues are subject to a yearly cost audit. Managers break down each hospital procedure in their department into supply, labor, professional fees, and other component costs. Costs are estimated in all remaining unstudied charges by a corporate-developed (Intermountain Healthcare Corporation, Salt Lake City, UT) cost allocation system.

A postdischarge satisfaction survey was administered by the cardiovascular nurse coordinator via telephone to 42 of the 46 critical pathway patients 1 to 3 days after discharge from the hospital. Four families were unable to be reached by telephone.

Statistics

Results are reported as mean ± 1 standard deviation. Tests used for comparative analysis include the two-tailed Students' *t* test for continuous variables and Fisher's exact test for categorical data. A value of *P* < 0.05 was considered significant.

... RESULTS ...

Control and Study Group Descriptions

From March 1995 to March 1996, 34 patients underwent repair of their ASD. Four patients were excluded due to coexisting cardiac anomalies, severe pulmonary disease, and/or additional surgical procedures to correct these anomalies. Seven patients were excluded due to valve involvement with the ASD repair. The average age of the 23 patients included in the 1995-1996 ASD study group was 7.8 years (median, 5 years; range, 7 months to 19 years). During the control period (1993), 37 patients underwent ASD repair. Seven patients were excluded due to coexisting cardiac anomalies, severe pulmonary disease, and/or additional surgical procedures to correct these anomalies. Two patients were excluded due to valve involvement with the ASD repair, and an additional two patients were excluded because their charts were unavailable for review. The average age of the 26 patients in the 1993 ASD control group was 5.8 years (median, 5 years; range, 1 to 17 years).

During the 12-month study, 38 patients underwent surgical repair for CoA. The study criterion of patient age older than 3 months excluded 24 patients; 4 patients were excluded for coexisting heart anomalies and/or concurrent PDA ligation; and

Table 1. Critical Pathway Results

Critical Pathways	ASD		CoA		PDA	
	Control	Study	Control	Study	Control	Study
No. of patients	26	23	12	9	20	14
Intubation time (h)	3.8 ± 5.2	2.1 ± 5.2	1.8 ± 3.4	0.4 ± 1.1*	1.6 ± 4.0	0 ± 0*
Time in ICU (h)	44.3 ± 17.1	31.3 ± 11.6*	67.2 ± 13.1	37.3 ± 12.4	34.1 ± 14.6	0 ± 0*
Aterial blood gas tests	12.7 ± 4.1	5.6 ± 2.7*	11.2 ± 4.1	1.7 ± 1.2*	2.0 ± 2.5	0 ± 0*
Total no. of laboratory tests	102.5 ± 19.8	58.1 ± 11.4*	81.4 ± 14.2	18.9 ± 8.6	43.1 ± 15.3	11.7 ± 5.5*
Morphine utilization (0.1-mg/kg doses)	10.0 ± 5.3	5.1 ± 3.2*	13.3 ± 5.6	9.2 ± 6.3	6.8 ± 3.1	1.6 ± 1.7*
Hospital length of stay (days)	4.9 ± 0.5	3.1 ± 0.7*	5.7 ± 0.6	3.2 ± 0.7*	4.1 ± 1.2	1.4 ± 0.4*
Total hospital charges (adjusted to 1996 dollars)	\$16,633 ± 1736	\$13,627 ± 1567*	\$14,292 ± 1103	\$8319 ± 1266*	\$8249 ± 1380	\$4216 ± 732*
Total hospital charges (adjusted to 1996 dollars)	\$13,785 ± 1977	\$11,914 ± 1303*	\$9565 ± 758	\$5482 ± 753*	\$5931 ± 1017	\$3030 ± 585*

ASD = atrial septal defect; CoA = coarctation of the aorta; PDA = patent ductus arteriosus; ICU = intensive care unit.

Note: Values are given as mean ± 1 standard deviation, and all amounts are in 1996 dollars.

*Significant difference (*P* < 0.05) between control and study groups.

1 patient was excluded because her hospital admission was 3 days before surgery for a nonsurgical condition. The average age of the 9 patients in the 1995-1996 CoA study group was 3.4 years (median, 4 years; range, 7 months to 19 years). During the control period (1993), 40 patients underwent surgical CoA repair. Study criterion of patient age older than 3 months excluded 23 patients, and 5 patients were excluded for coexisting heart anomalies and concurrent PDA ligation. The average age of the 12 patients in the 1993 CoA control group was 5.2 years (median, 4 years; range, 4 months to 13 years).

Twenty-six patients underwent ligation of the PDA during the 12-month study. The study criterion of patient age older than 1 month excluded 5 patients; 4 patients were excluded for coexisting heart and/or vessel anomalies; and 3 patients were excluded for other complicating physical conditions (1 each for brain tumor, severe pulmonary disease, and esophageal reflux). The average age of the 14 patients in the 1995-1996 PDA study group

was 2.5 years (median, 1 year; range, 1 month to 12 years). During the control period (1993), 28 patients underwent PDA ligation. Study criterion of patient age older than 1 month excluded 4 patients, and 4 patients were excluded for coexisting heart and/or vessel anomalies. The average age of the 20 patients in the 1993 PDA control group was 2.2 years (median, 1 year; range, 2 months to 12 years).

Clinical and Financial Results

Table 1 outlines the control and study group comparisons for mean intubation time, mean ICU time, arterial blood gas and total laboratory utilization, morphine utilization, average hospital length of stay, average total hospital charges, and average total hospital cost in 1996 dollars. There were significant reductions ($P < 0.05$) in all variables measured, with two exceptions. Mean postsurgical intubation time for ASD study patients was 2.1 ± 5.2 hours, which included a 24-hour intubation time for a 7-month-old ASD patient.

Table 2. Patient and Family Satisfaction Survey

Survey Question	Response	ASD	CoA	PDA	All
Before your child's surgery, were you able to discuss your child's condition?	Yes	20	7	13	40
	No	2	0	0	2
During your child's hospitalization, were you able to discuss your child's condition and receive sufficient answers to your questions?	Yes	22	7	13	42
	No	0	0	0	0
Using a scale of 1 to 5 (1 is lowest, 5 is highest, please take the experience you and your child had in the hospital)	1	0	0	0	0
	2	0	0	0	0
	3	1	0	2	3
	4	3	2	1	6
	5	18	5	10	33
How would you describe the amount of time you and your child spent in the hospital	Too short	1	2	2	5
	Appropriate	21	5	11	37
	Too long	0	0	0	0
Discharge: Did you receive sufficient information? Was the format understandable? Were all of your discharge questions answered adequately?	Yes	22	7	12	41
	No	0	0	1	1
Does your child have pain?	Yes	11	3	7	21
	No	11	4	6	21
Does the pain medicine appear to be working?	Yes	16	6	11	33
	No	0	1	0	1
	N/A	6		2	8
No survey done		1 patient	2 patients	1 patient	4 patients

ASD = atrial septal defect; CoA = coarctation of the aorta; PDA = patent ductus arteriosus; N/A = not available.

Note: An attempt was made to contact all critical pathway patients/parents 1 to 3 days postdischarge. We were unable to reach four patients by phone. Not all questions were answered by those surveyed.

Excluding this value from the mean time dropped the average intubation time to 1.1 ± 2.2 ($P < 0.05$) hours from the control group mean of 3.8 ± 5.2 hours, a significant change. Due to the wide variability of pain control needs among patients with CoA, reduction of morphine utilization, measured in 0.1-mg/kg doses, was not significant.

Satisfaction Results

A postdischarge satisfaction survey was administered by telephone to the parents of 42 of the 46 critical pathway patients. Perceptions of the patients' hospital stay, including pain control, were addressed. Table 2 contains the questions asked and the results. Nearly all respondents (40 of 42) felt comfortable discussing their child's condition with the physician before and during the hospitalization, and all discharge questions were addressed. The overall hospital experience was rated as "5" on a scale of 1 to 5 (5 being highest) by 79% of survey respondents.

Complications

There were 10 complications, all respiratory, in 8 patients in the study group: 2 pleural effusions (ASD), 4 atelectasis (3 ASD, 1 PDA), and 4 pneumothoraces (1 ASD, 3 PDA). There were 6 complications in 6 patients in the control group: 3 pericardial effusions (ASD), 2 atelectasis (1 ASD, 1 CoA), and 1 chylothorax (PDA). There were 3 readmissions in the study group: 1 day postdischarge for a pleural effusion (ASD); a pericardial effusion 7 days postdischarge (ASD); and a patient admitted for abdominal pain 7 days postdischarge, which was diagnosed as fecal impaction (CoA). There were 2 readmissions in the control group: 1 wound infection 3 weeks postdischarge (ASD), and 1 patient admitted 1 day postdischarge for seizures (CoA). Fisher's exact test showed no significant difference ($P < 0.05$) between control and study groups for complications or readmission rates.

Variations from Pathways

The potential and actual variations for each critical pathway are shown in Table 3. Reasons for variations from the critical pathways were categorized as patient/family, practitioner/caregiver, or system factors (Table 4). Examples of practitioner reasons for critical pathway deviation include a physician order that differs from the critical pathway, such as an extra laboratory test, or a missing order, such as failure to order monitoring as prescribed by the pathway.

Discharge occurred within limits of the critical pathway in 85% (39 of 46) of study patients. Seven patients were discharged late: 1 had continued pain, 1 patient was febrile, and 2 patients had continued nausea/vomiting.

... DISCUSSION ...

Nearly 20% of all cardiovascular surgeries performed in our institution can be classified as "simple," comprising noncomplex surgical repairs of single-defect ASD, CoA, or PDA. In this study, the use of critical pathways for postoperative care of patients with simple heart lesions resulted in significant decreases in resources used, hospital charges, and length of stay. In addition, patients and families were satisfied with their hospital stay and analgesia.

Table 3. Variations from Critical Pathways

Critical Pathway	Possible Variations	Mean Variations	Range
ASD	92	8.0	2-15
CoA	104	7.2	4-13
PDA	38	2.5	0-10

ASD = atrial septal defect; CoA = coarctation of the aorta; PDA = patent ductus arteriosus.

Table 4. Factors Causing Variations from Critical Pathways

Critical Pathway	Patient/Family Factors*	System Factors [†]	Practitioner/Caregiver Factors [‡]
ASD	113	1	69
CoA	35	2	28
PDA	17	0	18

ASD = atrial septal defect; CoA = coarctation of the aorta; PDA = patent ductus arteriosus.

*Include patient condition and patient/family availability.

[†]Include bed availability, delay in results or information, and supply/equipment availability.

[‡]Include physician orders, caregiver decisions, and order error or incorrect order.

Finally, there was minimal variation from the pathways.

Most authors^{2,4,9,14,17} agree that development of critical pathways must proceed carefully with wide interdisciplinary participation. However, reported development processes range anywhere from 6 months to 3 years. Our pathway was designed and implemented in 4 months, a relatively short period of time. Cardiothoracic surgeons directed the development process, and work was completed by pediatric intensive care nurses. This design method resulted in a rapid turnaround time between the decision to change practice and the actual implementation, which prevented uncontrolled and unwanted variation of the postoperative processes under study. Data from critical pathway patients were evaluated 6 months into the study to assure that these practice changes had a positive impact on the postoperative care of the cardiothoracic surgical patients.

Several studies^{3,10,11,14,18-22} relate the impact of critical pathways on intensive care and hospital length of stay, compared with either concurrent or retrospective control groups. We also report these data, in addition to more sensitive measures that explain the decrease in intensive care and hospital stays, such as length of mechanical ventilation and narcotic and laboratory utilization. Many protocols have been published on "fast-track" extubation of postoperative patients, particularly for adults.^{12,18,19} Fast-track extubation was incorporated into our critical pathways, resulting in significant decreases in postoperative intubation.

Pain control was also a vital part of the critical pathway. We used a "pain prevention" rather than a "pain management" approach, adapted from the work done by Turley et al.^{11,20} Some clinicians were skeptical that the administration of acetaminophen and ketorolac tromethamine as primary pain medication, followed by morphine as needed, would be sufficient to control pain in these patients. However, 79% (33 of 42) of the study patients surveyed reported postdischarge that the pain control regimen outlined in the critical pathway, with the emphasis on prevention, was adequate in all but one patient (if the answer to the survey question "Does your child have pain?" was "No," the follow-up question "Does the pain medication appear to be working?" was not asked on 8 patients). Narcotics were necessary to relieve pain for 85% of the study patients at some time during their stay. However, total narcotic utilization decreased, significantly so for morphine in

the ASD and PDA populations. With decreased use of narcotics, a patient's gastrointestinal motility is better, narcotic-induced nausea is not present, and the patient can resume normal nutrition and ambulate sooner. The combination of these factors, along with the emphasis on rapid rehabilitation,¹⁴ proved effective in achieving discharge within the limits of the critical pathway for 85% of the patients.

Many believe that laboratory tests, particularly arterial blood gases, are overused in intensive care units.^{23,24} Following implementation of the critical pathway, overall laboratory utilization decreased 43% for ASD patients and more than 70% for patients with coarctations and PDAs. Postoperative arterial blood gas utilization was down more than 50% in all diagnoses (see Table 1). We are not suggesting that these tests can or should be reduced in all postsurgical cases, but laboratory tests were clearly overutilized in our simple postoperative cases.

Better management of the postoperative stabilization and rehabilitation processes, combined with reduction in utilization of laboratory tests, resulted in lower total charges for the hospital stay. Reducing the total charges to our patients and payers was a major reason for implementing critical pathways. However, the postdischarge patient/parent satisfaction survey remains an important objective. Often, we fail to ask the very people impacted most by our practice—the patients—how it affects them. The majority (79%) of the critical pathway survey respondents (mostly parents of patients) rated their hospital experience as "5" on a scale of 1 to 5. The survey also addressed initial questions regarding time in the hospital and pain control. In both instances, most patients/parents felt that the length of time in the hospital was appropriate, and that the pain was well controlled (88% and 97%, respectively).

Several studies^{9,10,11,20-22} have reported on the use of critical pathway methods to care for postoperative patients with more complex congenital heart repairs such as ventricular septal defect (VSD) repair, Tetralogy of Fallot (ToF) repair, valve replacement, atrioventricular canal repair, conduit replacement, and Fontan procedure. Although we prepared and utilized critical pathways only for patients with simple surgeries, there was a spillover effect on more complex heart repairs done in our facility. We performed a preliminary analysis comparing hospital length of stay and total charges between the 1993 patients and March 1995-March 1996 (study group time period) patients having complex but repairable heart defects such as complex VSD repair, complete

ToF repair, conduit replacement, total anomalous pulmonary venous connection repair, and aortic, mitral, tricuspid, and pulmonary valve repair or replacement. Patient mix, diagnoses, and age distribution were similar between the two groups. There was a nonsignificant, with a trend toward significance, decrease in total hospital charges, from \$47,424 ± 41,557 in 1993 (n = 96) to \$37,108 ± 34,645 in 1995-1996 (n = 119) (*P* = 0.053; charges adjusted to 1996 dollars). Although not significantly so, mean hospital stay decreased as well, from 11.4 ± 10.9 days to 9.9 ± 10.8 days (*P* = 0.30). These spillover effects deserve further investigation.

The critical pathways were designed to allow flexibility and variances. Variance tracking allows critical pathways to be tailored for specific comorbidities.²⁵ Given the number of decision points on the critical pathways, there were relatively few variations per patient. More than half of all variances from the ASD and CoA critical pathways were due to patient factors. The reasons for variation from the PDA critical pathway were split between practitioner/caregiver factors and patient factors. Areas of the pathway where multiple variances occurred were changed to reflect actual practice. For example, 15 of 46 patients had nausea and vomiting that required antiemetic medication on operation day or postoperative day 1. The postoperative orders were changed, adding an antiemetic to the critical pathway. Fifty percent of ASD patients had electrolyte measurements on arrival to the PICU, and these tests were subsequently added to the critical pathway. Another interesting variation was the greater use of pain medication in older female patients (age > 10 years), perhaps because of the transverse submammary surgical incision used in these patients. The option of more oral narcotic pain relief such as oxycodone or acetaminophen with codeine was added to the pathway. Other variances were the result of inadequate education of the nursing staff to the pathways; for example, an infant being held fulfills the day 1 critical pathway requirement for "up in chair."

Some facilities report^{2,6} struggling with frequent clinician or caregiver variances from their critical pathways. However, we experienced relatively good compliance with the recommendations of the critical pathways. We theorize that this occurred because the critical pathways were initiated by the surgeons, and they were developed from the physicians' own day-to-day standard orders. There was wide participation in the development process, as well interdisciplinary support during the study, as

the plan of care for critical pathway patients was discussed daily in morning patient care rounds.

As with any prospective, nonrandomized study, a criticism is that a retrospective control group cannot truly match a current study group, given natural practice changes that occur over time. However, we felt that a true, prospective randomized study of these critical pathways, which would have eliminated this concern, would have been nearly impossible to support because of the nature of the postoperative care in our institution. We have one pediatric intensive care unit, staffed by a single team of healthcare providers. Since the inception of critical pathways on a portion of our patients, practice patterns have changed for all cardiovascular surgery patients, both intraoperatively and postoperatively. Nearly all cardiothoracic surgery patients are anesthetized with a fast-acting anesthetic to facilitate early extubation. Intercostal analgesia is widely used. In addition, laboratory and narcotic utilization on all cardiothoracic patients has been reduced.

A major weakness using a retrospective group as a control was that nonclinical data, such as satisfaction, were simply unavailable. We cannot conclude that the patients treated with a critical pathway were more satisfied with their care than the noncritical pathway patients. It was also difficult to measure how much variability of care existed within the retrospective control groups. We do know that postoperative orders for the control group patients were not uniform, and we know the amount of variability within the critical pathway patient group, but there was not a statistical measure of variability to compare the two groups.

... CONCLUSION ...

Implementation of critical pathways can be accomplished relatively quickly if the clinical staff responsible for care are committed to such an effort. In our experience, critical pathways reduced resource utilization and costs of postoperative care after repair of three simple congenital heart lesions, without obvious complications or patient dissatisfaction. Critical pathways also reduced inadvertent variation in patient care, allowing better assessment of future changes in clinical management. Critical pathways offer a useful tool for decreasing the costs and improving the quality of healthcare.

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