Published in final edited form as:

J Pediatr Surg. 2010 January ; 45(1): 167–170. doi:10.1016/j.jpedsurg.2009.10.031.

A Pediatric Acute Wound Service (PAWS): A Novel Approach in Wound Management

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Abstract

Introduction—In 2001, in response to an overwhelming increase in patient visits for various pediatric abscesses, burns, and other wounds, an ambulatory burn and procedural sedation program (PAWS) was developed to minimize Operating Room utilization. The purpose of this study is to report our initial seven year experience with the PAWS program

Methods—The hospital records of all children managed through PAWS from 2001-2007 were reviewed. Outcomes measured include patient demographics, number and location of visits per patient, procedure information, cause of wounds, and reimbursement. Chi-Square test and linear regression was performed using GraphPad Prism.

Results—Overall, 7620 children (age 0-18 years) received wound care through PAWS from 2001-2007. There were no differences in patient age, race, and gender during this time period. Between 2001 and 2007, the percentage of patients seen as outpatients increased from 51% to 68% ($p<0.05$), and the average number of visits per patient decreased from 3.9 to 2.4 ($p=0.05$). In, 2007, forty-six percent of the children required only one visit. In 2007, 74% of the visits were for management of wound and soft tissue infections, compared to only 9% in 2001 ($p<0.05$). The contribution margin of a PAWS visit and total contribution margin in 2007 was \$1052 and \$4.0 million, respectively.

Conclusion—The creation of PAWS has allowed for the transition in management of most pediatric skin and soft tissue wounds and infections to an independent ambulatory setting, alleviating the need for Operating Room resources, while functioning at a profitable cost margin for the hospital.

Keywords

PAWS; Wound Care; Skin and Soft Tissue Infection

Introduction

Multiple studies have documented a dramatic increase in the incidence of community acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) skin and soft tissue infections in children and adults.¹⁻³ Although there is no consensus on the optimal management of these soft tissue infections, treatment often requires an incision and drainage.⁴⁻⁵ In the pediatric population, this management typically requires utilization of the operating room to perform the procedure under adequate sedation. Given the vast number of affected patients, this practice can result in a significant burden on limited hospital resources.

We have previously reported our experience using a combined ambulatory burn care and procedural sedation (ABC-PS) program in the management of pediatric burns.⁶⁻⁷ Utilizing this approach, we were able to achieve a significant reduction in resource utilization for both

inpatient and outpatient pediatric burn care. In 2001, in response to the dramatic increase in community acquired skin and soft tissue infection seen at our institution due to CA-MRSA, we expanded the ABC-PS program to include the care of a variety of pediatric wounds and renamed it the Pediatric Acute Wound Service (PAWS). The purpose of this study is to report our initial seven year experience with the PAWS program.

Methods

Institutional Review Board approval for this retrospective review was obtained from the Washington University Human Research Protection Office (HRPO # 08-1018). The hospital records of all children managed through the PAWS clinic at St. Louis Children's Hospital from 2001-2007 were identified from an administrative database. Records were reviewed for patient demographics, diagnosis, procedures, visits, costs and charges. Patients were classified as having either burn or non-burn related wounds based on their billing CPT code. Burn care and procedural sedation (PS) was consistent with our previous reported protocols.⁷

The PAWS team consists of a specially trained Advanced Practice Nurse, employed through a collaborative practice agreement with the Division of Pediatric Surgery at Saint Louis Children's Hospital, along with 3 to 4 staff nurses and a pediatric hospitalist. A board certified Pediatric Surgeon is available for the clinic at all times. All incision and drainage procedures are performed by an Advanced Practice Nurse, appropriately supervised surgical resident housestaff, or the attending Pediatric Surgeon. All inhalation and intravenous PS is administered by a staff Hospitalist, board certified in Pediatrics, and credentialed by Saint Louis Children's Hospital to administer procedural sedation. All patients are monitored with a continuous electrocardiogram (EKG) and pulse oximetry and are observed post procedure in an adjacent recovery room prior to return to their hospital room or discharge home.

All data were entered into a personal computer using commercially available software (Excel 2003; Microsoft Corporation, Redmond, WA). Financial data analyzed included direct costs, patient reimbursement, and contribution margin. Direct costs were defined as costs related to patient care and typically included supplies, medications, and nursing support. Patient reimbursement was defined as insurance reimbursement for services billed through PAWS. The contribution margin was determined as the difference between patient reimbursement and direct costs. Statistical analysis was determined by Chi-square and linear regression (Prism 5.0, GraphPad Software Inc. San Diego, CA). All data are presented as mean $\pm$ SD. A p-value less than 0.05 was considered significant.

Results

Over the 7-year study period, 7806 children (aged 1 week through 18 years, mean 6.7 ± 5.7 years) were seen in the PAWS clinic for wound or burn care. The number of patients increased yearly from 501 in 2001 to 1569 in 2007 (Fig 1A, $p < 0.05$). The majority of patients treated ranged in age from 2-11 years old (42.2%), with children ≤ 1 year of age accounting for the next largest group (30.0%). Adolescents 12-17 years of age accounted for the smallest subgroup (27.7%).

The number of PAWS patient visits increased each year (1796 visits in 2001 vs. 4757 in 2007, $p < 0.05$). The average number of visits per patient, however, decreased from 3.2 ± 4.1 visits per patient in 2001 to 2.3 ± 2.0 visits per patient in 2007 ($p < 0.05$). Overall, the majority of patients (37%) required only one visit to the PAWS clinic, and seventy nine percent of patients were seen for less than three visits. There was not a significant difference between the number of patients requiring only one visit between 2001 and 2007 (40% vs 46%, $p = \text{n.s.}$). There were no significant differences in the number of visits per patient based on either patient location

(inpatient or outpatient) or type of wound the patient was being seen for (burn or other non-burn wound).

The inpatient PAWS volume remained constant during the study period (Fig 1B). During the first year, 985 inpatient visits occurred compared to 1089 in 2007 ($p = \text{n.s.}$). The increase in patient volume observed during this time period corresponded to a significant increase in outpatient visits over the same interval (811 visits in 2001 vs. 2701 visits in 2007, 45% vs. 71%, respectively, $p < 0.05$). When analyzed by diagnosis, both inpatient and outpatient burn wound visits remained constant throughout the study period. As the service grew, a dramatic increase in non-burn-related wounds were managed in PAWS (55 patients in 2001 vs. 1223 patients in 2007, 11% vs 87%, respectively, $p < 0.05$).

In order to identify the causes of the increase non-burn-related wounds, we used the ICD9 diagnosis code associated with each visit, as recorded in the administrative database, to identify the etiology of the patient wounds. The most common diagnoses associated with a PAWS clinic visit in 2007 is shown in Table 1. "S. Aureus Infection NOS," "Buttock Cellulitis," "Leg Cellulitis," and "Trunk Cellulitis," "Arm Cellulitis" were associated with 20.8%, 9.6%, 9.3%, 6.6%, and 3.5% of all PAWS clinic visits in 2007, respectively.

The percentage of patients requiring procedural sedation for their PAWS remained constant during the study period (49% vs. 48%, $p = \text{n.s.}$) The majority of inpatients required procedural sedation for their clinic visit (63%), compared to only 18% of outpatients. During the study period, there was a significant decrease in the number of sedations required per patient from 3.1 in 2001 to 1.8 in 2007 ($p < 0.05$).

The number of incision and drainage (I&D) procedures performed in the PAWS clinic dramatically increased on a yearly basis. In 2001, there were 35 I&D procedures performed compared to 310 in 2007 ($p < 0.05$). The majority of I&D procedures were performed on inpatients (99%). The recent institution of a direct referral policy for children with abscesses from outpatient clinics will likely change this volume.

In 2007, PAWS received \$8.78M in reimbursements for patient care and had a total direct cost of \$4.79M resulting in a positive contribution margin of \$3.99M or \$1052 per PAWS clinic visit. The average contribution margin for an inpatient visit was \$3504 versus \$63 for an outpatient visit. This difference between inpatient and outpatient contribution margins can be attributed to less reimbursement (\$7232 vs \$336) and less direct costs (\$3727 and \$272), respectively. Burn wound related visits had a direct cost of \$699 per visit, while non-burn related visits had a direct cost of \$1467 per visit.

Discussion

The management of skin and soft tissue infection is one of the most common problems seen by the pediatric surgeon. Providing wound care at the bedside is difficult without adequate anesthesia and analgesia and also puts the patients at risk for contamination due to difficulties in the maintenance of a sterile field. Procedural sedation has been successfully applied to the management of many pediatric therapeutic interventions. We have previously shown that addition of procedural sedation to an ambulatory burn center (ABC-PS) reduced resource utilization in the management of pediatric burns. [6,7] Due to an increase in pediatric community acquired soft tissue infections, and the burden placed on hospital resources, this program was subsequently expanded to cover a variety of pediatric wounds.

Over the 7-year study period our Pediatric Acute Wound Service was able to accommodate a dramatic increase in pediatric soft tissue infections managed at our institution, obviating the need operating room resources. As experience was gained in the management of these patients

under procedural sedation, the average number of visits per patient significantly decreased. In addition, a shift in their care to an outpatient setting was observed. Despite fewer contacts per patient, the significant increase in patient number has allowed PAWS to demonstrate a yearly increase in its contribution margin.

The retrospective nature of this study and its use of an administrative database create several limitations. Although, we believe the majority of children at our institution with wounds are seen in the PAWS clinic, there could still be patients managed with operative intervention. Patients were excluded from management through PAWS if they had an ASA score greater than 3 or had complex wounds required debridement or reconstruction. These children would be missed in our analysis. Second, from our experience we believe the major cause for the increase the pediatric wound seen in PAWS was due to an increase in skin and soft tissue infections requiring incision and drainage. However this administrative database used in our study does not contain any microbiologic information and it not possible to confirm this association.

Despite these limitations, we believe the PAWS program has provided a significant improvement in the care of children with skin and soft tissue infections. The children are seen in fewer visits and more frequently as outpatient. In addition, the time commitment to management of these wound required of already busy pediatric surgeons has been dramatically reduced. The development of an ambulatory wound service providing procedural sedation appears to benefit both the hospital and the patient.

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Figure 1.

Yearly trend in the number of patient and patient visits in the PAWS Clinic from 2001-2007. (A) Number of patients seen in PAWS clinic yearly divided in to inpatients (checkered) and outpatients (bar). (B) Number of patient visits in PAWS clinic yearly divided into visits related to burn wounds (checkered) or non-burn wounds (bar). $P < 0.05$ for trend by Linear Regression.

The ICD9 Diagnosis codes associated with a PAWS visit for the five most common diagnosis codes from 2001–2007. Discharge diagnosis information was pulled from a hospital administrative database for all inpatient and outpatient PAWS visits from 2001–2007 and the ICD9 codes were sorted based on total number of visits associated with each diagnosis code

Table 1

ICD9	Diagnosis Description	Year							
		2001	2002	2003	2004	2005	2006	2007	
4111	S. AUREUS INFECTION NOS	28	31	185	673	1013	829	787	
6825	BUTTOCK CELLULITIS	8	15	99	257	381	341	363	
6826	LEG CELLULITIS	6	17	85	226	368	302	353	
6822	TRUNK CELLULITIS	10	19	70	173	228	213	251	
6823	ARM CELLULITIS	3	8	31	109	194	130	131	