Medical Paediatric Admission Patterns at the University Hospital of the West Indies: Issues for Future Planning

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ABSTRACT

An understanding of the epidemiological trend in hospital admissions, including morbidity and mortality patterns and the economic impact, is critical for healthcare planning and appropriate resource allocation. Data were collected on all admissions to the paediatric unit of the University Hospital of the West Indies during the period 1999. Each observation included demographic data, admission and discharge data and billed cost of care. There were 1350 admissions (570 female and 715 male, $p < 0.001$*). Admissions "lows" were observed in February, April and July; minor peaks in March and June and the major peaks between October and January coincided with admissions due primarily to respiratory conditions. The evening shift was generally the busiest, with the night shift having the lowest average number of admissions in any one-week period. Occupancy was uniformly high between November and April, with minor lows in May and August/September. The total cost for a typical patient was J$9708 per admission and the total daily cost for a typical patient was J$1823 (US$1 = J$39 in 1999). The findings could assist with resource allocation and rationalization of health services.*

Patrones de Ingresos Médico-pediátricos en el Hospital Universitario de West Indies: Agenda Para Planes Futuros

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RESUMEN

Entender la tendencia epidemiológica en los ingresos al hospital, incluyendo los patrones de morbilidad y mortalidad así como el impacto económico, resulta fundamental a la hora de planificar la atención a la salud y asignar los recursos de forma apropiada. Los datos fueron recopilados en todos los ingresos a la unidad pediátrica del Hospital Universitario de West Indies durante el periodo de 1999. Cada observación incluyó los datos demográficos, los datos de ingreso y alta, y los costos facturados para la atención médica. Hubo un total de 1350 ingresos (570 hembras y 715 varones, $p < 0.001$*). Los periodos "bajos" de ingresos se observaron en febrero, abril, y julio; los picos menores en marzo y junio, y los picos mayores en octubre y enero coincidían con ingresos debidos fundamentalmente a problemas respiratorios. El turno de la tarde-noche era generalmente el más ocupado, teniendo el turno de la noche el número promedio más bajo de ingresos en cualquier período de una semana. La ocupación del hospital se mantuvo uniformemente alta entre noviembre y abril, con bajas en los meses de mayo y agosto/septiembre. El costo total de un paciente típico fue de J$9708 (dólares jamaicanos) por ingreso, y el costo total diario por cada paciente típico fue de J$1823 (US$1 = J$39 en 1999). Los hallazgos podrían ser de utilidad en relación con la asignación de recursos y la racionalización de los servicios de salud.*

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INTRODUCTION

Recognition of epidemiological trends in hospital admission patterns, and the economic impact are critical to healthcare planning and resource allocation. Essential strategies include the development of user-friendly, standardized reporting protocols consistent with international standards and the creation and maintenance of computerized databases. These will facilitate timely generation of data for reporting, and research opportunities (1, 2). The development of a large computerized database can be challenging in resource-constrained countries but is necessary for timely systematic auditing and quality assurance procedures (3).

Treatment costs also provide fundamental information for guiding healthcare policy, and are often under-reported in clinical research. Cost data are typically available on an individual-patient level, to give a total cost per patient. The distribution of costs is generally highly skewed, reflecting high costs incurred by some patients because of type of medical complications, extended hospital stay, and degree of specialist investigation and intervention. Healthcare planners require information on the total hospital budget, and the arithmetic mean is the required summary measure. Median cost (often presented in cost research) can be interpreted as the cost for a typical patient, but does not provide information on total costs.

At the Section of Child Health, University Hospital of the West Indies (UHWI), Jamaica, monthly audit of admission-related morbidity and mortality is conducted. Anecdotal review revealed differences in reporting content and style, with resultant overlap and inconsistency in reported morbidity data. It was decided to conduct an audit of the medical paediatric admission patterns (including treatment costs) at the institution using a standardized reporting protocol, with a view to understanding the epidemiological trends, estimate the economic impact, identify challenges and inconsistencies, and to propose strategies for future healthcare planning and resource allocation.

SUBJECTS AND METHODS

The UHWI is one of the major tertiary care institutions in Jamaica. The Paediatric medical unit consists of two wards with a 44-bed complement. The unit accepts patients 12 years of age and under from the general emergency department, outpatient clinics, community-based paediatricians and family physicians and other local and regional hospitals.

During the period January 1 to December 31, 1999, data were available on 1305 admissions to the paediatric unit of the UHWI. The primary data source was the admission/discharge register, which was located on each of the wards. Additional data were obtained from the Medical Records and Statistics and Accounts (Assessment) Departments.

Observations included patients' registration number, age, gender, address, referral source, admission date and time, discharge date, duration of hospitalization, average daily occupancy, definitive discharge diagnosis and billed charges. Charges were assessed by the Accounts Department based on actual costs incurred for daily room and board, investigations, drugs and disposables. Occupancy was defined as the number of paediatric patients admitted to and resident in the hospital for part or all of any single day, and data were presented as the proportion of beds occupied (% occupancy). The final primary discharge diagnosis was coded using the International Classification of Diseases, Ninth Revision (ICD-9) nomenclature. In the case of patients with multiple diagnoses, the principal investigator on review of the relevant hospital records selected the primary discharge diagnosis. Diagnoses were also grouped according to the affected organ system.

The hospital day was stratified into three 'duty' shifts (night 00:00 – 07:59 hrs, day 08:00 – 15:59 hrs, and evening 16:00 – 23:59 hrs), since work time is a fundamental factor for planning resource allocation.

The data on cost were derived from individual patient bills per admission obtained from the Accounts Department of the hospital. The charges/cost were classified as *average cost* (the cost per person, *ie* the cost per hospital admission, measured using the arithmetic mean); *total cost* (the entire costs borne by a financial unit; in this case, the financial unit was stratified into diagnostic groups and the total cost per diagnostic group calculated by multiplying the arithmetic mean by the number of admissions); *typical cost* (the cost for a typical admission – that is the most common type of admission; typical cost was measured by using the median cost or 50^{th} percentile of distribution). Median absolute deviation (MAD) as an equivalent to standard deviation was used to describe the distribution average for the typical patient.

Attempts were made to obtain missing data through supplementary data sources. Observations were entered into a Microsoft Office Access database programme. Univariate statistical analyses were applied using Stata 7 (4).

RESULTS

Missing data

There were 744/1305 (57%) complete admission records. Most of the incomplete records were due to incomplete admission costs (525/1305 or 40.2%). Time of admission was unavailable in 49 (3.8%) cases, date of discharge unavailable in 30 (2.3%) cases, and referring unit and ICD-9 coding each was unavailable in 12 (0.9%) cases.

Demographics

There were 1305 admissions among 1096 patients and 968 patients had a single admission. Cumulatively, 201 repeat admissions occurred among 128 patients during the year. Of these repeat admissions, 45 were within one week, 95 were within one month, 128 within two months, 148 within three months, 179 within six months, 195 within nine months, and 201 within twelve months.

Admission by gender, diagnosis and referral source

There were 570 female and 715 male admissions representing significantly more males than females (binomial test $p < 0.001$). Mean (SD), median and range of age at presentation for male and female were: 3.43 years (± 3.57), 2 years (IQR 0–6, range 0–12) and 3.34 years (± 3.39), 2 years (IQR 1–5, range 0–12) respectively; frequency curves were the same (not shown) and mean difference was 0.09 years (95%

CI–0.29, 0.47 and $p = 0.65$ by independent samples t-test). Admission by diagnostic category, referral source and gender is presented in Table 1 (a, b). Respiratory, haematological and gastrointestinal conditions were the commonest reasons for admission, by referral mainly from Accident and Emergency and Casualty Departments and community-based paediatricians. Admissions were greatest among infants and children under the age of two years.

Table 1: (a) Number of admissions by diagnostic category and gender

Diagnostic group	Male (%)	Female (%)	Total (%)
Respiratory	262 (35.9)	138 (24.4)	400 (30.9)
Haematological	101 (13.9)	103 (18.2)	204 (15.8)
Gastrointestinal	88 (12.1)	78 (13.8)	166 (12.8)
Miscellaneous	80 (11)	71 (12.5)	151 (11.7)
Neurological	63 (8.6)	60 (10.6)	123 (9.5)
Cardiovascular	50 (6.9)	50 (8.8)	100 (7.7)
Renal	61 (8.4)	36 (6.4)	97 (7.5)
Dermatological	13 (1.8)	17 (3)	30 (2.3)
Endocrine	9 (1.2)	6 (1.1)	15 (1.2)
Ophthalmological	2 (0.3)	7 (1.2)	9 (0.7)

Table 1: (b) Number of admissions by referral source and gender

Referring unit	Male (%)	Female (%)	Total (%)
General Accident and Emergency	254 (34.8)	194 (34.6)	448 (34.7)
Private paediatricians	140 (19.2)	100 (17.8)	240 (18.6)
Paediatric casualty	134 (18.3)	84 (15)	218 (16.9)
Paediatric outpatient clinic	54 (7.4)	60 (10.7)	114 (8.8)
Sickle Cell Unit	49 (6.7)	42 (7.5)	91 (7)
Elective	35 (4.8)	38 (6.8)	73 (5.7)
Other hospital	39 (5.3)	14 (2.5)	53 (4.1)
Other ward	18 (2.5)	21 (3.7)	39 (3)
Tropical Metabolism Research Unit	6 (0.8)	4 (0.7)	10 (0.8)
Home	2 (0.3)	3 (0.5)	5 (0.4)
Centre for HIV/AIDS Research, Education and Services	0 (0)	1 (0.2)	1 (0.1)

Admission by time

Weekly admission totals exhibited large variance and a four-week moving average allowed anecdotal examination of the graph (not shown) for underlying trends after ‘smoothing’ these weekly totals. Admissions “lows” were apparent in February, April and July, with minor peaks in March and June. Admissions rose to a major peak between October and January. There were an average of three admissions per day (IQR 2–5; range 0–10).

Hospital admission for the four main diagnostic categories (respiratory, gastrointestinal, haematological, and neurological) is presented in Fig. 1. The minor March peak seemed due to increases in respiratory and gastrointestinal problems, and the minor June peak due entirely to an increase in respiratory problems. The major end of year peak was again due to an increase in respiratory problems.

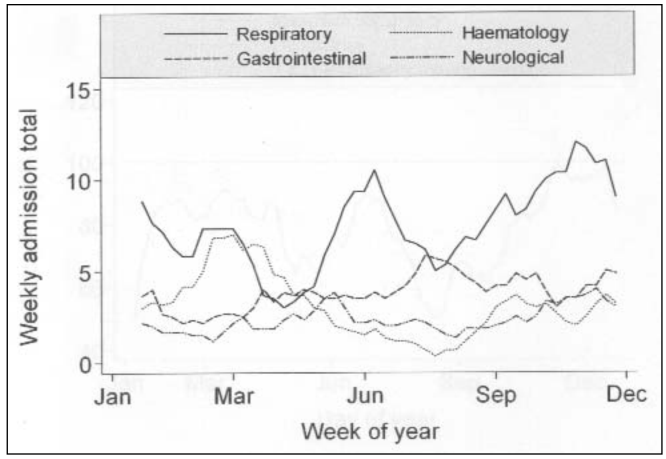

Fig. 1: Weekly admission total for four common clinical diagnoses.

Admission levels during each of the morning, day and night shifts were examined using the four-week moving average. The evening shift was generally the busiest, followed by the day shift, with the night shift having the lowest average number of admissions in any one-week period.

Occupancy

Daily occupancy levels are presented in Fig. 2, using a seven-day moving average. The average daily occupancy rate varied between 50% to 98% (beds occupied) per day. Occupancy was uniformly high between November and April, with minor lows in May and August/September (note that the initial low at the start of the year was an artefact of the limited study window).

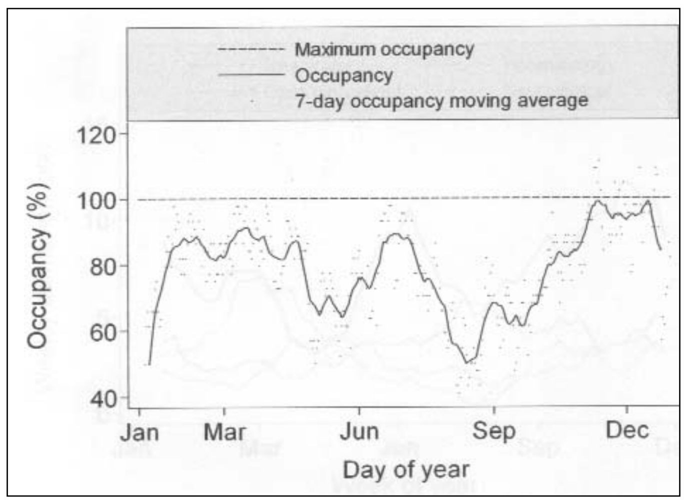

Fig. 2: Daily occupancy with 7-day moving average

Length of hospital stay is summarized as follows: median stay (± median absolute deviation) was 3 (± 1) days for gastrointestinal diagnoses, 4 (± 2) days for respiratory diagnoses, 5.5 (± 3.5) days for neurological diagnoses, 6 (± 3) days for cardiovascular diagnoses, 6 (± 2) days for dermatological diagnoses, 7 (± 4) days for haematology diagnoses, 8 (± 4) days for ophthalmological diagnoses, 10 (± 5) days for renal diagnoses, and 11 (± 4) days for endocrine diagnoses. Median hospital stay for infection-related diagnoses was 5 (± 2) days, and for all others was 6 (± 3) days.

Treatment Cost

The distribution of average patient costs was generally highly skewed to the left, reflecting high costs incurred by some patients based on type of medical complications, extended hospital stay, mode of investigations and therapy.

Table 2 (a) provides average and typical costs *per patient* for nine clinical diagnosis categories (typical patient is 50th percentile of the distribution). Table 2 (b) provides average and typical costs *per patient per day* (US$1 = J$39 in 1999). The crude total cost *per patient* was J$15 124 (± 18 390) and the total cost for a typical patient was J$9708 (± 4882). The crude total cost *per patient per day* was J$2352 (± 2746) and the total daily cost for a typical patient was J$1823 (± 461).

Table 2: (a) Average total cost per patient, and total cost for a typical[1] patient among nine clinical diagnosis categories

Diagnostic group	Number	Average total costs (J$) Arithmetic mean (sd)	Typical total cost (J$) Median (mad)[2]
Respiratory	227	9789 (9838)	7597 (2814)
Haematology	121	16 368 (14,778)	12 515 (7095)
Gastrointestinal	103	8 763 (7,889)	6 395 (2535)
Miscellaneous	91	19 911 (31,495)	9700 (4230)
Neurological	63	19 122 (25,673)	11 215 (6030)
Cardiovascular	66	20 783 (17,509)	17 180 (9781)
Renal	66	23 253 (17 829)	16 628 (7701)
Dermatological	22	13 650 (17 698)	6 996 (1605)
Endocrine	12	14 768 (7744)	14 070 (4410)
Ophthalmological	8	33 444 (32 350)	22 093 (11 063)

Table 2: (b) Average total cost per patient per day, and total cost per day for a typical[1] patient among nine clinical diagnosis categories

Diagnostic group	Number	Average stay (days)	Average total costs (J$) Arithmetic mean (sd)	Typical stay (days)	Typical total cost J$ Median (mad)[2]
Respiratory	223	7.2	1963 (842)	4	1770 (378)
Haematology	119	9.8	2123 (1645)	7	1770 (415)
Gastrointestinal	102	5.2	2361 (2416)	3	1890 (455)
Miscellaneous	88	10.5	2687 (3463)	5	2076 (551)
Neurological	62	11.8	3368 (6585)	5.5	1975 (611)
Cardiovascular	66	14.2	3392 (3306)	6	2055 (814)
Renal	65	12.3	1926 (977)	10	1566 (279)
Dermatological	21	8.8	1762 (775)	6	1733 (355)
Endocrine	12	10.5	1557 (554)	11	1418 (402)
Ophthalmological	8	15.7	2515 (1571)	8	1871 (239)

[1]Refers to the median or 50th percentile of the distribution
[2]Median absolute deviation (MAD) is an equivalent to standard deviation when we use median instead of mean to describe a distribution average

DISCUSSION

During the year of review, the data suggest that the majority of admissions were single admissions, with a significantly greater male to female preponderance and there was increased frequency of admissions in younger children and infants less than two years of age. Respiratory, haematological, gastrointestinal and neurological conditions were commonest and respiratory conditions accounted for the major peak in the admission period between October and January. Duration of hospitalization and treatment cost were skewed to reflect conditions attributable to endocrine, ophthalmological, renal and haematological complications.

It was interesting to note the gender difference in admission pattern, since this was not consistent with the population gender proportions for children 1–9 years during 1999 [1–4 years: 116 665 M, 114 704 F; 5–9 years: 133 449 M, 133 490 F; 10–19 years: 247 431 M, 254 406 F] (5). It may reflect a gender bias in parental health-seeking behaviour regarding their children (6). Alternatively, there may be epidemiological reasons for male susceptibility to infections or other conditions requiring admission. The peak in respiratory conditions during October and January however, is certainly consistent with national and global epidemiological trends, especially regarding influenza and other pertinent viral respiratory infections (7, 8). Respiratory disorders usually dominate the admission spectrum of disorders, especially in the infants and children less than two years of age (9–13). During 1999, diseases of the respiratory system were the leading first-listed discharge diagnosis for children 1–4 years in Jamaica (33.3% of discharges; 143.3 per 10 000 population). Respiratory disorders were also the leading cause of hospital deaths for children 1–4 years in the same year (27.9% of deaths; 1.0 per 10 000 population) (5).

There are other factors, including socio-economic and parental educational status, and environmental factors, which could influence admission patterns (10, 14). The availability and quality of medical care are also important influences on the likelihood of hospitalization for paediatric medical conditions for which outpatient alternatives may be available (15), although these were not explored in the study. There were admission "lows" in April and July, which coincided with the Easter and summer school vacations and probable decrease in the opportunity for the transmission of infectious diseases.

Most of the admissions were self-referred through the Accident and Emergency Department and Paediatric Casualty, similar to trends in other series (6, 12). The unique relationship between the UHWI, Jamaica, and the Sickle Cell Unit accounted for a substantial number of children being referred with acute problems attributed to sickle cell disease (including acute chest syndrome), and may have contributed to frequent and prolonged hospital stay.

The busiest admission period occurred during the evening and this was fairly consistent for most of the year and at a time when just a small cadre of emergency doctors were available. Alternatively, if patients reported early in the disease and during the day, they could have more staff attending to them and hence, shorter periods of stay, earlier discharge, and investigations and follow-up through outpatients services. The ratio of health personnel to patients can impact on waiting time and quality of care (6,16), but was not explored in this study. Issues regarding the triage of patients in the emergency and casualty settings, waiting time and expediency of transfer to the admission wards deserve further evaluation.

The median (± MAD) length of stay (5 ± 2 days for infection-related diagnoses; 6 ± 3 days for other diagnoses) was similar to the overall average length of stay at UHWI during 1999 (mean stay – UHWI: 6.3 days; mean stay – Jamaica: 5.1 days) (5). The type of complications, frequency and complexity of investigations and modalities of treatment influenced the duration of hospitalizations for patients with endocrine, renal, ophthalmological and haematological diagnoses. In addition to patients with cardiovascular problems, these accounted for the highest average daily patient costs (Table 2 a, b). Some of these investigations and treatment modalities could possibly have been done after a short stay stabilization period and then followed more closely in the outpatient department. With concomitant rising cost of healthcare, this has implications for sustainable client access and the quality of health provision. Healthcare systems must strive to provide an efficient and effective service.

The efficiency of a service is defined as the resources needed to obtain a given level of benefit from that service. The efficiency point is when an incremental unit of resources allocated to a service produces equal incremental units of benefits to the service. At resource levels lower than the efficiency point, a good service can produce benefits that are worth more than the additional costs needed to obtain those benefits. At resource levels higher than the efficiency point, the benefits produced, although still positive, are worth less than the additional allocated resources. In healthcare, more expensive care may still be "more efficient" because the improvement in patient outcomes and quality of life outweighs the added costs (17). However, there are difficulties in applying this definition of efficiency to clinical medicine. Costs are difficult to quantify, unless based on unsubsidized profit-making by health providers; many studies rely on hospital charges or payments to the hospital, which do not represent the actual costs to either the hospital or society (18). Alternatively, strategies in primary and secondary prevention can be enhanced to reduce paediatric morbidity and admissions to hospitals, with resultant positive impact on overall costs (13, 19).

The data from this study identified patients with ophthalmological, cardiovascular, renal and neurological diagnoses as having the longest duration of stay and incurring the highest costs. Review of these cases suggested that hospital costs could be efficiently minimized by reducing hospital stay through regular, short elective admissions for pertinent investigations and modalities of treatment. Exploration of treatment cost was limited by missing data and inconsistencies in reported morbidity and admission data. To pro-pose strategies for resource allocation and improving efficiency would require a more comprehensive audit and include the evaluation of staff-patient burden, expediency of patient management, resource availability and patient satisfaction surveys. The findings suggest that healthcare providers could be anticipatory in the management of human and infrastructural resources, given the observed epidemiological pattern of paediatric hospital admissions.

Respiratory diagnoses accounted for a significantly greater male to female ratio (chi-square 19.92, df = 1, p = 0.058). This represents selection bias and could explain why there were more males than females in the sample. Furthermore, during periods with peaks of especially respiratory diseases, the maximum occupancy was occasionally exceeded and patients would be temporarily accommodated on the paediatric surgical ward (not part of this study).

The average bed occupancy at UHWI during 1999 was 68%, and 72% for the Child Health Department (source: University Hospital of the West Indies, Department of Medical Records and Statistics and Ministry of Health, Planning and Evaluation Branch). From inspection of other years, occupancy during 1999 was similar to trends for the immediate preceding and following years. However, the authors are unable to identify specific gaps in efficiency, because of missing cost data.

In conclusion, the findings have increased understanding of paediatric admission trends at this institution. Costs to patients could be minimized by optimizing outpatient management and reduction in redundant stay, treatment, and investigations. Hospital costs could be improved by maximizing occupancy and bed turnover rate. The authors suggest that a comprehensive evaluation of patient and hospital related factors be conducted to determine possible gaps in efficiency. The findings underscore the need for development and implementation of unified, consistent protocol-driven initiatives to assist monitoring and evaluation in the health services.

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