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Causes & risk factors for unscheduled readmissions in the paediatric ward of a major public hospital

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***Background & objectives*: Readmissions are often considered as an indicator of poor quality of care during previous hospitalization, although many of these are unavoidable or unrelated to the past admission. The identification of high-risk cases for readmissions and appropriate interventions will help not only reduce the hospital burden but also to establish the credibility of the hospital. So this study aimed to determine the readmission percentage in the paediatric wards of a tertiary care hospital and to identify the reasons and risk factors that can help minimize preventable re-hospitalizations.**

***Methods*: This prospective study from a public hospital included 563 hospitalized children, classified as first admission or readmissions. Readmissions were defined as one or more hospitalizations within preceding six months, excluding scheduled admissions for investigations or treatment. Reason-wise, the readmissions were classified into various categories, based on the opinion of three paediatricians.**

***Results*: The percentage of children getting readmitted within six, three and one month time from the index admission was 18.8, 11.1 and 6.4 per cent, respectively. Among readmissions, 61.2 per cent were disease-related, 16.5 per cent unrelated, 15.5 per cent patient-related, 3.8 per cent medication/procedure-related and 2.9 per cent physician-related causes. Patient- and physician-related causes were deemed preventable, contributing to 18.4 per cent. The proximity of residence, undernutrition, poor education of the caretaker and non-infectious diseases were associated with increased risk of readmission.**

***Interpretation & conclusions*: The findings of this study suggest that readmissions pose a substantial burden on the hospital services. The primary disease process and certain sociodemographic factors are the major determinants for the increased risk of readmissions among paediatric patients.**

Key words Admissions - hospitalization - paediatric readmissions - preventable readmissions - readmission rate - ward

Hospitalization is a major cause of anxiety and inconvenience to the patient as well as the family/caretakers[1]. Repeated hospitalizations further aggravate these problems, adding an element of uncertainty and sometimes, casting doubt on the credibility of the health care service[2]. Each readmission also adds burden to the limited health resources, especially in public hospitals[3]. Readmissions are often considered as an indicator of the quality of care provided during previous hospitalization[4]. For instance, some insurance agencies in the United States penalize hospitals with high readmission rates[5]. However, all readmissions are

not avoidable and may be unrelated to the previous hospitalization. Even related readmissions might be preventable or non-preventable.

Potential reasons for readmission reportedly include causes related to the natural course of the disease or its complications, errors on the part of physicians at the time discharge from previous hospitalization, non-compliance of post-discharge advice by patient/caregiver or development of unrelated illness[6]. Some readmissions are merely for the purpose of planned investigations or treatment cycles. High readmission risk may also be related to other host factors rendering a person susceptible to re-hospitalizations, *e.g.* chronic illnesses[7], severe malnutrition or environmental factors[8]. Studies (mainly from developed countries) have shown that 20-40 per cent of readmissions in children are potentially preventable with better clinical management and appropriate discharge planning during the previous admission along with good post-discharge follow up and care with early intervention in domiciliary setting[9-11]. Unlike adults, the issue of re-hospitalization in children has received less attention. Previous studies on paediatric population have usually focused on the readmission trends in children with specific diagnoses, *e.g*. asthma[12], and have demonstrated reduction in readmissions with suitable interventions[13,14]. The studies from developed countries have concurred that readmission rates in children are relatively less as compared to adults and majority of them are non-preventable[11,15]. Since only a few paediatric studies are available in the Indian literature to analyze the readmission profile, the present study was designed to analyze probable causes and risk factors for readmissions in children served by a large public hospital.

The present study was aimed to determine the percentage of unscheduled readmissions in the paediatric ward of the study hospital, to identify reasons for these readmissions and whether some of these could have been prevented and analyze the demographic and clinical characteristics of these cases, to identify risk factors for repeated hospitalizations.

Material & Methods

This descriptive study was conducted prospectively in the department of Paediatrics, Seth G.S. Medical College and KEM Hospital, Mumbai (a tertiary care teaching hospital in a metropolitan city from Western India), from April 2016 to September 2017, after clearance from the Institutional Ethics Committee. The study hospital predominantly caters to the low socio-economic strata of urban slums and also serves as a major referral centre of western India. Using an online calculator[16], a sample size of 563 hospitalized children was found to be adequate for this study with a confidence level of 95 per cent and confidence interval (CI) of 4, considering that approximately 9000 admissions would occur during the study, based on the previous experience. A sample size of 484 was calculated to compare the case characteristics of readmissions with fresh admissions, for a confidence level of 95 per cent, power of 80 per cent, hypothetical readmission rate of 20 per cent and the least extreme odds ratio of 2[17]. Thus, a sample size of 563 was considered adequate for both main objectives, *i.e.* to assess the readmission percentage as well as to compare the characteristics of first admissions with those of the readmissions.

All consecutively hospitalized children in the age group of one month to 12 yr with indoor registration number ending with three, five, seven and nine, were included in the study (after obtaining a written informed consent from the parent/s and assent from children 7 yr and above), till the sample size was achieved. Cases with planned admissions for investigations, treatment cycles or hospitalizations outside the study hospital were excluded. A first admission was defined as those without any previous history of hospitalization in the study hospital in the preceding six months. A readmission was defined as one or more unplanned hospitalizations within six months of the first admission. However, infants born in the same hospital and admitted within six months of age for some illness were not considered as readmissions. If a patient who was initially included in the first admission category got readmitted and satisfied the inclusion/exclusion criteria, then he/she was moved into the readmission category. Cases with multiple readmissions were not re-enrolled if included during the first readmission.

Desired demographic and clinical information regarding each enrolled case was recorded based on the history, examination, review of case records and previous discharge cards, if applicable. Diagnosis recorded on previous discharge ticket (among readmissions) or made by the respective treating unit (first and readmissions) was considered final and entered in records. All cases were managed by the respective treating unit. An attempt was made to classify the probable cause of all readmissions under one of the following five sub-headings: disease-related, caregiver-related, physician-related, medication/procedure-

related or unknown/unrelated reason for readmission, based on the unanimous or majority opinion of three trained paediatricians ('expert's opinion'), other than investigators. Disease-related causes included worsening of the disease process/complications of the primary disease, recurrence of the primary disease with evidence of improvement after the first hospitalization, despite adequate compliance. Caregiver-related causes included poor compliance with advised medications or discharge instructions (despite documented correct instructions regarding subsequent visits, continuation of advised/prophylactic therapy, collection of pending reports), discharged against medical advice or absconded during the previous admission, poor follow up, faulty feeding practices and poor hygiene practices. Physician-related causes included premature discharge with incomplete recovery during the previous admission as per records (discharge cards), wrong diagnosis of the disease or its extent during the previous admission, as per records (discharge cards), inadequate or wrong instructions at the time of discharge or on discharge cards. Medication/ procedure-related causes included adverse effects of medications advised on discharge from the previous admission (provided the patient was compliant with the dosage instructions), adverse events, (*e.g.* infection, *etc.*) following a procedure or intervention barring all other contributory causes. Unrelated causes included unknown cause of readmission which could not be concluded from the available evidence and records and the reason for readmission was unrelated to the previous one. Cases with physician-related or patient-related cause of readmission were considered as preventable admissions while those with disease-related, procedure-related or unrelated causes were considered as non-preventable.

Statistical analysis: Logistic regression analysis was carried out with readmission ratio as the dependent variable with the factors such as nutritional status, education of the primary caretaker, residence, vaccination status, per capita income, age at the time of first admission, gender, aetiology of illness, type of family and mode of admission as the independent variables. All the variables with $P<0.05$ were considered significant and evaluated further with multivariate analysis. STATA version 11.1 software (StataCorp LP, Texas, USA) was used for statistical analysis.

Results

Out of the 563 chidren enrolled, 14 were excluded from analysis due to inadequate data. Thus, of the remaining 549 children of hospitalization; 160 (29.1%) were infants, 171 (31.1%) were toddlers and preschoolers (< 5 yr age), while 218 (39.7%) were older children. The gender ratio was 1.46:1 in favour of males. Aetiologically, 38.6 per cent of all cases were of infective aetiology while the rest were admitted due to non-infective systemic illnesses. While infectious diseases and systemic infections were responsible for 42.2 per cent of first admissions, only 23.3 per cent readmissions were of infective origin. Acute respiratory infection was the most common cause of the first admission. Nephrotic syndrome was the leading cause of readmissions. The aetiological diagnosis in first admissions and current readmissions is given in Table I.

Of the 549 cases analyzed, 103 were readmissions with a six month readmission percentage of 18.8 per cent, (95 per cent CI: 15.7-22.2). Among these, 24 (23.3%) had multiple readmissions. About two thirds of all readmissions occurred within three months of discharge with three month readmission percentage of 11.1 per cent (CI 95%: 8.8-14) and one third within the first 28 days of discharge thereby with a one-month readmission percentage of 6.4 per cent (CI 95%: 4.6-8.7).

Analyses of the causes of readmissions revealed that majority of the readmissions (61.2%) were due to disease-related causes. Another 16.5 per cent were due to unrelated causes and 3.8 per cent due to medication/

Table I. Aetiological diagnosis in first admissions and current readmissions

Diagnosis	Total (n=549)	First admissions (n=446)	Readmissions (n=103), n (%)
Renal disorders	53	33	20 (37.7)
Gastrointestinal disorders	31	20	11 (35.5)
Haematological disorders	49	34	15 (30.6)
Cardiovascular system	41	30	11 (24.4)
Respiratory system	23	18	05 (21.7)
Neurological disorders	104	90	14 (13.5)
Systemic infections	132	113	19 (14.4)
Infectious diseases	80	75	05 (06.2)
Miscellaneous	36	33	03 (08.3)

Table II. Probable reasons for readmissions as per expert's opinion

Reason	n (%)	Details and number of cases
Disease-related	63 (61.2)	Nephrotic syndrome (11 cases), congenital heart disease (8), aplastic anaemia (5), chronic infections (5), seizure disorder (4), asthma (3), others (27)
Unrelated	17 (16.5)	Chronic disease with unrelated illness (6), different aetiologies (4), infections with different systemic involvement (4), unknown (3)
Patient-related	16 (15.5)	Poor compliance (7), poor follow up (2), poor feeding practices (1), poor hygiene practices (1), discharge against medical advice in previous admission (5)
Medication/ procedure-related	04 (03.8)	Ethambutol-induced optic atrophy (1), rifampicin-induced rash (1), shunt infection (1), post-intubation tracheal stenosis (1)
Physician-related	03 (02.9)	Pre-mature discharge (2), misdiagnosis (1)

procedure-related unpredictable complications. Thus, about 81.5 per cent of cases were non-preventable. Table II gives the probable reasons for readmissions as per the expert's opinion. About onefifth (18.4%) of the readmissions (CI 95%: 12.1-27.0) were considered preventable, due to caregiver related (15.5%) or physician-related factors (2.9%). After multivariate analysis, it was seen from the odds ratio that patients with residence in close proximity to the hospital were 3.6 times (1.9-6.8) more likely to be readmitted as compared to those residing outside the residence ward of the hospital. Likewise, patients with severe undernutrition with weight for age <60 per cent of the expected, education of the primary caretaker less than tenth standard and non-infective systemic illness were twice more likely to get readmitted (Tables III and IV). Gender, type of family, per capita income, mode of admission and immunization status were not found as significant risk factors in these cases (Table III).

Discussion

Reported readmission rates in literature vary widely between three and 30 per cent due to population characteristics and more importantly, the duration over which the readmission was considered in the calculation of readmission rates[6,7,18-22]. Most of the reported paediatric readmission studies are from large population cohorts of developed countries using electronic data records. These reported readmission rates range from 2.3 per cent[23] within one week, 3-7 per cent[6,18,19] within one month to 16-21 per cent[7,24] within one year after discharge. Children from the developing countries like India are expected to have a higher risk of re-hospitalizations due to a relative lack of preventive health care and follow up facilities after discharge. However, readmission rate in the present study was comparable to western studies, once adjusted for the time frame. There are only a few reports of readmission rates from Indian hospitals, ranging from two[25] to 30 per cent[26] usually in adults or mixed population. Studies from adults or the general population often report higher readmission rates than exclusive paediatric studies, perhaps due to the preponderance of chronic lifestyle diseases in elderly patients[11,19].

The median time interval between index admission and readmission in this study was 84 days (range 12 h-6 months) with 3.8 per cent readmissions within seven days of discharge and 38.8 per cent within a 30 day period. Comparatively, in a multi-centric American study[18], 39.0 per cent of all readmissions were within the seven days and 61.6 per cent within the first 14 days of discharge. In another study from the USA, the median time interval between index and re-admission was 9.5 days[4]. In this study the hospital involved was a public hospital which caters to the needs of the underprivileged population. This population usually defers re-hospitalizations due to economic constraints or inadequate understanding of the severity of the disease or its consequences. For the same reason, a longer time frame of six months was selected to define the readmission as the short 30 day period would have underestimated the readmission percentage.

A child may need readmission either due to the course or a complication related to the previous illness or because of a totally unrelated and a new illness. In India, it is expected that a large burden of readmissions may be due to poor nutritional and environmental conditions, rendering the population susceptible for new infections and illnesses. However, in this study, majority of the readmissions were due to the course or complication of the previous illness, with only 16.5 per cent being due to unrelated causes. Studies

Table III. Univariate analysis of case characteristics in first admission *vs.* readmissions

Case characteristics	Total cases	First admission (n=446)	Readmission (n=103), n (%)	*P*	OR (CI 95%)
Gender					
Male	326	260	66 (20.2)	0.317	1.27 (0.8-1.9)
Female	223	186	37 (16.6)		
Proximity of residence					
Same ward	64	43	21 (32.8)	0.003	2.4 (1.3-4.2)
Outside the ward	485	403	82 (16.9)		
Nutritional status					
WFA>60%	407	344	63 (15.5)	0.001	2.14 (1.3-3.3)
WFA<60%	142	102	40 (28.2)		
Immunization status					
Unimmunized	397	325	72 (18.1)	0.514	1.15 (0.7-1.8)
Fully immunized	152	121	31 (20.4)		
Aetiology					
Infective	286	246	40 (13.9)	0.003	1.9 (1.2-3.0)
Non-infective	263	200	63 (23.9)		
Education of primary caretaker					
>10th standard	397	340	57 (14.3)	0.000	2.5 (1.6-4.0)
<10th standard	152	106	46 (30.2)		
Per capita income/month (INR)					
<3000	353	289	64 (18.1)	0.611	0.8 (0.5-1.3)
≥3000	196	157	39 (19.8)		
Type of family					
Nuclear	507	413	94 (18.5)	0.645	0.8 (0.3-1.8)
Joint	42	33	9 (21.4)		
Mode of admission					
Outpatient department	149	121	28 (18.7)	0.850	1.0 (0.6-1.7)
Emergency services	400	325	75 (18.7)		

WFA, weight for age; OR, odds ratio; CI, confidence interval

Table IV. Multivariate analysis of the case characteristics in first admission *vs.* readmissions

Case characteristics	OR	*P*	95% CI
Age at the time of first admission	1.0	0.03	1.0-1.0
Proximity of residence	3.6	0.000	1.9-6.8
Nutritional status	2.1	0.002	1.3-3.4
Education of the primary caretaker	2.6	0.000	1.6-4.2
Infective aetiology	2.1	0.002	1.3-3.2

from the developed countries have also reported comparable observations with only 13-27 per cent[6,19,20] readmissions due to unrelated causes.

Studies have also shown that 2-47 per cent[10,11,27-29] of all readmissions are potentially preventable, depending on the yardsticks used to label them as preventable. Unlike this study, Wallace *et al*[6] found that preventable admissions were twice more likely due to physician-related than the caregiver-related causes. A similar preponderance of physician-related issues has been reported in other studies, some in adults, from western countries[30,31]. This difference seems to be more due to the under-recognition and under-reporting of physician-related causes in India rather than the rarity of the problem. Further, physician-related errors, to some extent, in the Indian setup are masked by the higher contribution of caregiver-related factors due to health ignorance and economic issues. Disease-related causes were responsible for majority (61.2%) of readmissions

in this study, similar to previous reports[7,18,22,28,32]. These cases were either related to the course or complications of the previous disease *per se*. Being a tertiary care referral hospital, the study centre received a large number of cases with chronic systemic illnesses, *e.g.* seizure disorders, congenital heart diseases, chronic kidney diseases and haematological disorders, which often need repeated hospitalizations. Infectious diseases rarely led to readmissions, except in chronic infections, *e.g*. tuberculosis and HIV. Readmissions in many of these chronic diseases could be avoided by timely and appropriate ambulatory care, *e.g*. in asthma or seizure disorders. Berry *et al*[18] observed that four of the ten most prevalent readmission conditions were ambulatory care sensitive, including asthma, gastroenteritis, pneumonia and seizure.

Many studies have attempted to identify high risk cases for readmissions to provide more intensive follow up plan for continued medical aid even after discharge to prevent readmissions, though most of them focused on children with specific diagnoses, *e.g*. asthma, congenital heart diseases, *etc*.[32]. Readmission rates are expected to vary with clinical diagnosis, with cases having long protracted and recurrent course, *e.g*. bronchial asthma, seizure disorders, nephrotic syndrome and congenital heart diseases, requiring more frequent readmissions than one-time events, *e.g*. infections[15,33]. Similarly, the disorders with high mortality will expectedly have lower readmission rates. While there is a paucity of Indian literature on this aspect, many studies from the developed countries have also reported the age, diagnosis on index admission and presence of chronic conditions as risk factors for readmissions in children[3,7,30,31,33-37]. Some others have also found gender, length of hospital stay during the index admission, number of past admissions and presence of comorbidities as significant risk factors for readmissions[3,32,35,36,38,39].

The present study was conducted within the realm of available resources and had some limitations including small sample size as compared to studies from developed countries, inability to develop a model to predict readmission risk, as the study was not designed as a case-control study and inability to calculate and compare the readmission percentages as well as case characteristics, respectively, between public and private hospitals.

Overall, the present study suggests that readmissions pose a substantial burden on hospital services. The primary illness and certain sociodemographic factors are responsible for the increased risk of readmissions in paediatric population. However, one fifth of readmissions are potentially preventable. Efforts should be made to predict the risk of re-hospitalization at the time of discharge and to prevent them by appropriate measures, *e.g*. targeted counselling regarding compliance and linkage with outdoor health care services in the periphery. The development of integrated health information systems across the administrative barriers would help to keep a track of discharged patients from the hospitals and ensure timely interventions, if required, to avoid re-hospitalizations.

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