Objective: To evaluate the ability of a regionalized system to safely transfer patients requiring admission from a referral center to either regional or community hospitals.

Design: Cohort study of children requiring admission. Following transfer, a questionnaire was administered to eligible caregivers. Subsequent emergency department (ED) use was assessed by comparing children who were transferred with those who were not.


Participants: Caregivers of 371 children who underwent transfer from a tertiary care center ED to either a regional or a community hospital were eligible; 344 were contacted. Two hundred fifty-three children for whom transfer was considered but was not performed served as a comparison group.

Intervention: Questionnaire administered to caregivers, combined with database review.

Main Outcome Measures: Failure of the transfer process, caregiver satisfaction, and future tertiary care center ED use.

Results: Five children experienced intravenous access problems, and 4 children experienced delayed antibiotic administration. Caregiver satisfaction was 92.3% with the transfer process and 84.4% with the care at the receiving hospital. Forty-seven percent of caregivers indicated that they would agree to a similar transfer in the future. Two years later, fewer transferred children (39.9%) than those who were not transferred (49.6%) had revisited the tertiary care center ED (odds ratio, 1.52; 95% confidence interval, 1.10-2.10). The mean number of visits was unchanged (95% confidence interval of the difference, −0.44 to 0.21 visits).

Conclusions: Although we found the redistribution program to be safe, caregivers stated a preference not to be transferred again. The redistribution system did not substantially alter tertiary care center ED use.

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In 1996, the Ontario Health Services Restructuring Commission was established to restructure Ontario’s public hospitals and to recommend investments that would facilitate the creation of an integrated health services system. The commission envisioned a regionalized system of pediatric care that provides the appropriate level of care as close to the patient’s home as possible. A directive delivered to The Hospital for Sick Children, Toronto, Ontario, Canada, a pediatric tertiary care center, was to develop a plan for the transfer of primary and secondary levels of care from the tertiary care center back to the regional and community centers. This process was developed to promote a regionalized system of emergency department (ED) and inpatient care. The importance of such systems has been identified by the Institute of Medicine.

Because inpatient bed shortages contribute directly to ED overcrowding, it has been hypothesized that the use of a redistribution system would minimize the effect of a local inpatient bed shortage on ED overcrowding. To the best of our knowledge, the system we describe is a unique model in North America. Although there exists literature describing the transfer of patients to tertiary care centers, none to date exists on the transfer of patients from tertiary care centers to either regional or community hospitals. This study’s primary objective was to determine the fail-
ure rate of the redistribution system. Secondary outcomes included caregiver satisfaction with the redistribution process and the effect on future ED use.

STUDY DESIGN

This cohort study is based on data from a consecutive series of patients who were transferred from the ED of The Hospital for Sick Children between April 1, 2003, and March 31, 2004. Their caregivers (parent or responsible adult accompanying the child) were contacted within 1 month of transfer and were administered a telephone questionnaire. Excluded were families that lived outside the greater Toronto area, as they are less likely to revisit the ED of The Hospital for Sick Children. Those not reached after 3 attempts were deemed to be lost to follow-up. This study was approved by the institution’s research ethics board.

SETTING

The Hospital for Sick Children is located in downtown Toronto. It serves patients from a broad demographic and socioeconomic spectrum and is the sole pediatric tertiary care center in the greater Toronto area. The ED has 31 patient care beds, including the trauma and resuscitation rooms, urgent care facility, and observation unit. Within the Toronto area, community hospitals provide inpatient care to children with a limited acuity of illness and a high probability of hospital discharge within 48 hours. Regional centers provide the complete scope of services for their local community, including children requiring subspecialty pediatric care or those who have complex health problems.

In 1990, The Hospital for Sick Children entered into an alternative funding agreement with the provincial government. Remuneration arising from services rendered was exchanged for a set amount of funding, with 50% allocated to patient care and the remainder devoted to research and educational activities. When funding renegotiations occur, clinical care volume is used in the discussions. Therefore, although an indirect incentive to provide greater volumes of clinical care exists, there is no direct revenue incentive to The Hospital for Sick Children or to its physicians.

SELECTION OF PARTICIPANTS

To meet the redistribution directive, the top 10 diagnoses, procedures, and lengths of hospital stay by diagnosis were identified and were classified as primary and secondary or as tertiary and quaternary. It was determined that the Division of Paediatric Medicine had the largest number of cases and days appropriate for redistribution. Therefore, the division developed and piloted a comprehensive approach to planning patient redistribution. Clinical features that would preclude redistribution were identified. These included a need for specialized diagnostic testing, the presence of substantial comorbidity, or multiservice consultation or pediatric intensive care support. In addition, diagnosis-based exclusion criteria were drafted to exclude the transfer of children considered to be at increased risk for deterioration or those who required subspecialty consultation (Table 1).

TRANSFER PROCESS

All children who are seen at the ED of The Hospital for Sick Children and who are assessed as requiring admission are screened for redistribution. Eligible patients include those who live beyond the immediate (approximately 16.1 km²) catchment area of The Hospital for Sick Children and who do not meet any redistribution exclusion criteria. If the closest hospital does not have any available beds, then other hospitals are sequentially contacted based on proximity to the child’s home. Once an available bed is located, consent is obtained from the family, the receiving physician is contacted, and the child is transferred directly to the pediatric unit. If no bed is located, the child is admitted to The Hospital for Sick Children. The redistribution process occurs 24 h/d and 7 d/wk. During the study period, the ED had an assigned discharge planner 10 h/d and 7 d/wk. When the discharge planner is not present, the ED physicians arranged the transfer, with clerical assistance provided by the unit clerk.

Primary care pediatricians in the greater Toronto area are not routinely notified of the intent to transfer, as few provide 24-hour coverage for their patients, and their affiliation does not determine the location of transfer. Nevertheless, because the receiving institution is determined by geography and because most children receive their primary care close to home, the transfer often results in the children being cared for by their pediatrician. During evening hours, inpatients at many of Toronto’s hospitals are cared for by assigned pediatricians (hospitalists), who transfer care to the primary care providers during daytime hours.

METHODS OF MEASUREMENT

Within 1 month of transfer, an employee at The Hospital for Sick Children contacted the caregivers of all eligible children.

Table 1. Diagnosis-Based Transfer Exclusion Criteria

<table>
<thead>
<tr>
<th>Diagnosis-Based Transfer Exclusion Criteria</th>
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<tr>
<td>General</td>
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<tr>
<td>- Difficult intravenous access</td>
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<tr>
<td>- Severe hyponatremia (&lt;130 mmol/L), hyponatremia (≥150 mmol/L)</td>
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<tr>
<td>- Rule out sepsis</td>
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<td>- Septic shock</td>
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<td>- Respiratory distress</td>
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<tr>
<td>- Impending respiratory failure</td>
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<tr>
<td>- Previous intensive care unit admission</td>
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<tr>
<td>- Fractional inspired oxygen ≥ 30%</td>
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<tr>
<td>- Notable chest x-ray film abnormality (large pleural effusion)</td>
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<tr>
<td>- Receiving nebulized salbutamol more frequently than every hour</td>
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<tr>
<td>- Received nebulized epinephrine &gt; 2 times in 4 h</td>
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<tr>
<td>Seizure</td>
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<tr>
<td>- Changed seizure pattern, with persistent seizure activity</td>
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<tr>
<td>- First seizure lasting &gt; 30 min or &gt; 2 seizures in 24 h</td>
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<tr>
<td>Oncology*</td>
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<tr>
<td>- Ongoing blood product requirement</td>
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<tr>
<td>- Suspicion of typhilitis</td>
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<tr>
<td>- Neonatal jaundice</td>
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<tr>
<td>- Likelihood of exchange transfusion</td>
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<tr>
<td>- Infectious</td>
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<tr>
<td>- Hemorrhagic fever, malaria, human immunodeficiency virus, or tuberculosis</td>
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<tr>
<td>- Urinary tract infection with underlying known or suspected structural abnormality</td>
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<tr>
<td>- Cellulitis if possible invasive group A streptococcal etiology, underlying musculoskeletal or orbital involvement</td>
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<tr>
<td>- Hematology</td>
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<tr>
<td>- Sickle cell disease</td>
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<tr>
<td>- Other</td>
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<td>- Solid organ transplant recipient</td>
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*Oncology patients are only transferred to a community hospital with a formal oncology satellite relationship to The Hospital for Sick Children.
by telephone and administered a standardized 14-item questionnaire. The questionnaire was developed internally with input from administrators, physicians, nurses, and hospital discharge planners. It consisted of the following sections: general information, the transfer process, transport to the community hospital, care at the community hospital, and plan for future ED visits. Questions related to satisfaction and complications were binary close-ended questions. All other questions were open-ended. All patient satisfaction and minor complication data were obtained during the telephone survey.

Age, triage acuity score, diagnosis, interval until transfer, distance to hospitals, presence of intravenous cannula, number of ED visits at The Hospital for Sick Children since transfer, and need for a transfer back to the tertiary care center (because of major complication) were extracted by electronic medical record review. The Hospital for Sick Children also maintains a data warehouse that provided the following information: total number of ED visits, time from admission decision until transfer, ED and inpatient census data, and outcome data related to discharge planner consultations. All other data not specified were obtained from the caregivers during survey administration.

Diagnosis was assigned based on the actual diagnosis recorded on the transfer sheet for children who were transferred and in the ED medical record for children who were admitted to The Hospital for Sick Children. The following diagnoses were grouped to facilitate interpretation: seizure (febrile and afebrile), gastroenteritis (vomiting, diarrhea, gastroenteritis, and dehydration), respiratory distress (asthma exacerbation, pneumonia, bronchiolitis, croup, and pertussis), feeding difficulty (poor feeding, gastroesophageal reflux, feeding tube problem, and failure to thrive), fever (febrile illness, fever, fever of unknown source, fever with associated neutropenia, febrile infants <3 months of age, and Kawasaki disease), and viral illness (viral illness, infectious mononucleosis, nasal congestion, upper respiratory tract infection, pharyngitis, stomatitis, and cutaneous herpes simplex virus).

OUTCOME MEASURES

The primary outcome was the proportion of children whose transfer was a failure, defined as a need for transfer back to The Hospital for Sick Children (major adverse event) or any problem that occurred during the transfer process or at the community institution (minor adverse event). Major adverse events include complications such as respiratory failure, cardiac arrest, necrotizing fasciitis, status epilepticus, and renal failure, as these events would almost surely result in a transfer back to the tertiary care center. Minor complications included loss of intravenous access en route, intravenous difficulties at the community hospital, and a delay in care that included medication administration or investigations and consultations. All major adverse events were likely to be captured, as The Hospital for Sick Children is the only pediatric tertiary care center in the region and is the only facility with pediatric critical care beds. Secondary outcomes included caregiver satisfaction with the transfer process and care at the community hospital, as well as future tertiary care center ED use.

To assess the effect of the redistribution process on future ED visits and on time to admission, we compared children who were transferred with those who were not transferred. Those who were not transferred included children who were assessed for transfer by our discharge planner but who ultimately were admitted to the tertiary care center. This group of children was anticipated to be similar for age, diagnosis, and distance to the hospital to the group of children who were actually transferred. The number of future ED visits was abstracted from the medical records on November 1, 2005, by a data abstractor blinded to the study’s hypothesis.

PRIMARY DATA ANALYSIS

The 12-month data collection period was expected to generate a sample size sufficient to yield stable estimates of the primary outcome measure. Sample size was calculated by estimating a 5% failure rate. To provide a 95% confidence interval (CI) with a maximal width of 6% and an α = 0.05, a minimum of 291 subjects was required.

The analysis assessed all data provided in the questionnaires. Data were investigated in descriptive, exploratory, and qualitative manners. For qualitative categories, grouping was performed using a priori defined categories, with results expressed using descriptive statistics. Dichotomous variables were analyzed using the χ² test or Fisher exact test when appropriate. Age, time of discharge planner consult, time of discharge, and interval to discharge were compared between groups using the Mann-Whitney test; distance to The Hospital for Sick Children and future ED use were analyzed using 2-sample t test. Analysis of the distance from the family home to the receiving hospital and to The Hospital for Sick Children was performed via paired t test. Canadian Emergency Department Triage and Acuity Scale assessment, diagnosis, and the presence of intravenous access at the time of transfer were analyzed using contingency tables with the χ² test of independence. All statistical tests were 2-tailed, with P < .05 as the threshold level of statistical significance. Data analyses were performed using SPSS software version 14.0 (SPSS Inc, Chicago, Illinois).

RESULTS

Between April 1, 2003, and March 31, 2004, there were 43,201 patients seen in the ED, and 5995 (13.9%) were admitted or transferred (Figure). The mean time from admission decision to actual transfer to an inpatient unit peaked in November 2003 at 8 hours and 35 minutes. At that time, on average, 34.2% of ED beds were occupied by admitted patients, and the inpatient census was at 106.0% of capacity.

Among patients evaluated by the discharge planner, 504 children were successfully transferred to other institutions, 252 were admitted to The Hospital for Sick Children, and 102 were discharged home because adequate clinical improvement occurred before a bed became available. One hundred thirty-three children lived outside the greater Toronto area and were ineligible for the study. Therefore, surveys were attempted for 371 of the transferred children. Ninety-three percent (344 of 371) were completed successfully.

CHARACTERISTICS OF TRANSFERRED SUBJECTS

Thirty-eight percent of caregivers were directed to bring their child to the tertiary care center by a primary care physician. Respiratory illnesses were the most common diagnosis among transferred children (Table 2). Seventeen different hospitals, a mean of 37.0 km from the tertiary care center, received patients; however, 49% went to 3 hospitals. The mean distance from family home to receiving hospital was 47% less than the distance from family home to The Hospital for Sick Children (11.7 vs 22.0 km; 95% CI of the difference, −8.5 to −12.1 km). Interfacility transports occurred via family car in 63.3% of the cases, by taxi in 18.6% of the cases, and by ambu-
interval in 17.3% of the cases. Three medically stable pregnant teenagers (1.2%) walked to an adult facility across the street. The frequency of intravenous access did not vary by method of transportation \((P = .98)\).

**MAIN RESULTS**

No major complications occurred. Nine transfers (2.6%; 95% CI, 1.4%-4.9%) met the definition of minor failure. Complications included loss of intravenous access en route \((n = 1)\), delayed antibiotic administration \((n = 4)\), and intravenous access difficulties at the community hospital \((n = 4)\). None of these complications resulted in any adverse outcomes, and no children required transfer back to the tertiary care center.

Questionnaire findings are given in **Table 3**. Overall, 92.3% of caregivers were satisfied with the transfer process. Of those who were dissatisfied, the most commonly stated concern \((n = 9)\) was the impression that they were not given the option to remain at the tertiary care center. The perceived reason stated by 81.3% of parents for the transfer was a lack of bed space at the tertiary care center; only 8.5% stated that it would enable them to be closer to home.

Overall, 84.4% \((266 of 315)\) of caregivers were very satisfied with the care their child received at the community hospital. Although 92.7% of caregivers believed the community hospital was adequately prepared for the arrival of their child, 10 stated that the receiving institution did not know that their child was being transferred, 4 thought that registration took too long, and 3 were unhappy that a room was not ready when they arrived. The caregivers of 46.5% of the children surveyed indicated that they would agree to a transfer to a community hospital if their child required admission in the future; however, 42.7% indicated that they would decline the transfer. If their child required another ED visit, only 20.8% stated that they would go to their community hospital.

**COMPARISON WITH CHILDREN ADMITTED TO THE TERTIARY CARE CENTER**

Transferred children were compared with 253 children who were not transferred. Those who were not transferred were admitted to the tertiary care center. The groups comprised similar ages, triage acuity scores, diagnoses, and distance to the tertiary care center (Table 2 and **Table 4**). Children who were transferred left the ED on average 6.2 hours sooner than children who were admitted to the tertiary care center \((P < .001)\) (Table 5). Since the index visit, a greater proportion of those who were not transferred had revisited the tertiary care center ED at least once \((49.6\% vs 39.9\%; odds ratio, 1.52; 95\% CI, 1.10-2.10)\); however, the mean number of visits was similar between groups \((93\% CI of the difference, −0.44 to 0.21 visits)\).

**COMMENT**

The results of this study provide reassurance regarding the safety of the redistribution system. Physician decision making for diagnosis, disease severity, suitability for transfer,
and method of transportation allowed for the safe implementation of the redistribution system. These positive achievements are tempered by the findings that many parents would not agree to a similar transfer in the future and that most would bring their child back to the tertiary care center, although we were unable to document delayed antibiotic administration, may minimize any effect the transfer has on delayed antibiotic administration.

Because safety is of paramount importance, it is concerning that 4 children experienced a delay in antibiotic administration and that 5 children experienced intravenous access difficulties. However, because of the stable condition of the population being transferred, these events did not result in any substantial complications. Although we were unable to document delayed antibiotic administration among children admitted to the tertiary care center, delayed antibiotic administration is associated with ED overcrowding. In the future, better communication with the receiving hospital, as well as improved timing of the transfer in relation to antibiotic administration, may minimize any effect the transfer has on delayed antibiotic administration.

Although this process was devised to allow children to be cared for at facilities close to home, it also alleviates the strain placed on tertiary care centers. Recent findings have highlighted that a lack of available inpatient beds is the most notable factor resulting in delayed treatment for ED patients. In fact, admissions held in the ED have a progressive linear effect on waiting times, patient care times, and total ED length of stay. Therefore, by accessing inpatient beds at other institutions, the redistribution system may reduce the effect of the bed shortage at the referring facility.

The high proportion of transfers that occurred by car or taxi was possible because these children were medi-
cally stable, and although they required ongoing care, the severity of their illness was not high. The decision regarding mode of transportation is at the discretion of the ED physician and requires consideration of disease processes, acuity, urgency, practicality, resource allocation, and parental desire. Although some parents reported being uncomfortable driving their child from one hospital to another, the frequency of intravenous catheter loss was extremely low regardless of method of transfer. Children requiring oxygen (because of asthma, pneumonia, or bronchiolitis) were transported by ambulance, and those who may have potentially required advanced life support were not candidates for transfer.

Encouraging caregivers to use their local health care facilities might allow for a reduction in the number of patients requiring transfer. However, referral to a tertiary care center may be based on concerns regarding available pediatric resources in nontertiary care centers. United States data recently revealed that only half of EDs are stocked with 85% of the recommended equipment and supplies. Canadian research has similarly found that essential pediatric resuscitation equipment is frequently unavailable and that its unavailability is associated with a low percentage of pediatric visits. The absence of certified pediatric emergency medicine physicians in regional and community center EDs may also play a role in referral to tertiary care centers.

The need to develop a regionalized and coordinated system of care is not unique to Canada. In the United States, 90% of level I trauma centers and hospitals with more than 300 beds operate at or above capacity. These numbers have led the Institute of Medicine to recommend the development of an integrated system of regionalized emergency care. The redistribution system used in the greater Toronto area does not violate the terms of the Emergency Medical Treatment and Labor Act enacted by the US Congress, as all patients transferred undergo a medical screening examination and have a determination made regarding the presence of an emergency medical condition. Should such a condition exist, the child would not be a candidate for transfer and would remain at the tertiary care center. With respect to the receiving institution, the Emergency Medical Treatment and Labor Act requirements are met in that the institution must have the available space and qualified personnel to treat the patient and his or her condition. The transfer also must use qualified personnel and transportation equipment as necessitated by the patient’s condition. The patient’s condition may eliminate the use of the family car or a taxi for the transfer process.

Although the generalizability of such a process may be most relevant to other publicly funded health care systems, in private systems there exists an economic motivation to the payer for transferring patients away from tertiary care centers. Costs in academic medical centers in the United States are 83% higher than those for urban nonteaching hospitals, and charges for inpatient childhood asthma care are higher at urban teaching hospitals compared with nonteaching and rural hospitals. Two Canadian studies have reached similar conclusions.

This study has certain limitations. The failure rate was calculated using data obtained from parental report, with verification of substantial adverse events performed by medical record review; therefore, the accuracy of reporting of minor adverse events cannot be verified. It would have been ideal if the occurrence of minor adverse events could be compared between groups; however, the data are unavailable for children who were transferred. Minor adverse events, while important, also occur at tertiary care centers; therefore, their presence is not an indicator of inappropriate care at the receiving hospital. We used an invalidated caregiver telephone survey to measure complications in clinical care. Although there is evidence that conducting parental interviews after a substantial adverse event yields data that are superior to those of physician follow-up and that telephone surveys are a reliable means of monitoring for the occurrence of medical errors, no data exist (to our knowledge) on the validity of caregiver telephone survey tools to detect complications in clinical care. Although the number of complications occurring during the transfer process or at the outside institution may be underestimated because of recall bias, it is unlikely that any substantial complications were overlooked, as The Hospital for Sick Children is the only pediatric tertiary care center in the city and medical record review determined that no children were transferred back to our institution during the study period.

Telephone survey following the transfer of children as part of a pediatric admission redistribution program detected few adverse events. Redistribution systems are capable of achieving a high degree of caregiver satisfaction while relieving some of the strain on tertiary care center EDs. Although the redistribution program may be capable of reducing future tertiary care center ED visits, there exists a reluctance on behalf of caregivers to allow the child to be transferred should the need arise again. Therefore, the implementation of a redistribution system alone cannot be expected to substantially alter future tertiary care center use.

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Correspondence: Stephen B. Freedman, MDCM, MSc, FRCP(C), Division of Paediatric Emergency Medicine, Department of Paediatrics, The Hospital for Sick Children, 555 University Ave, Toronto, ON M5G 1X8, Canada (stephen.freedman@sickkids.ca).

Author Contributions: Dr Freedman had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Freedman and Thakkar. Acquisition of data: Freedman and Thakkar. Analysis and interpretation of data: Freedman. Drafting of the manuscript: Freedman and Thakkar. Critical revision of the manuscript for important intellectual content: Freedman and Thakkar. Statistical analysis: Freedman. Administrative, technical, and material support: Thakkar. Study supervision: Freedman.

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