Oral rehydration therapy in Malawi: impact on the severity of disease and on hospital admissions, treatment practices, and recurrent costs

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In the first 2 years following refresher training of paediatric staff in oral rehydration therapy (ORT) and the establishment of an oral rehydration unit at the Kamuzu Central Hospital, Lilongwe, Malawi, there was a 50% decrease in the number of children admitted to the paediatric ward with the diagnosis of diarrhoeal diseases, a 56% decrease in the use of intravenous fluid to rehydrate such children, a threefold increase in the use of oral rehydration salts (ORS) exclusively to rehydrate children with mild or moderate dehydration, and a 39% decrease in the number of paediatric deaths associated with diarrhoeal diseases. Over the same period, there was a 32% decrease in recurrent hospital costs attributable to paediatric diarrhoeal diseases. As use of ORT continues to increase in Malawi, where diarrhoeal diseases account for 9% of paediatric hospital admissions, there should be considerable decreases in mortality from such diseases and concomitant increases in cost savings attributable to them.

Introduction

Oral rehydration therapy (ORT) using oral rehydration salts (ORS) is the recommended treatment for uncomplicated dehydration that accompanies diarrhoeal diseases. Use of ORT in hospitals leads to decreases in paediatric mortality associated with diarrhoeal diseases as well as in the number of days of hospitalization for children with such diseases and in the cost of treatment of dehydration (1–5). Also, correct use of ORT in outpatient departments decreases the number of inpatient admissions for diarrhoeal diseases, a factor of significant importance in countries with limited resources (6).

In Malawi, ORT was introduced to paediatric inpatient services in 1977, with daily supplies of ORS to each paediatric ward, and to outpatient services in 1984, when outpatient oral rehydration units were established in major hospitals throughout the country. Kamuzu Central Hospital (KCH) in Lilongwe, the capital, was one of the first hospitals to begin outpatient ORT activities. In 1984, before an outpatient ORT unit was set up at KCH, paediatric staff received refresher training in ORT that emphasized assessment of dehydration as well as the use of intravenous fluids and ORS according to WHO recommendations.

In 1987 a review of the records of paediatric inpatients over the period 1981–86 was carried out at KCH to evaluate retrospectively the impact of the refresher training on hospital practices for dehydration associated with acute diarrhoeal diseases and of outpatient ORT activities on the number, severity, and cost of paediatric admissions for such diseases.

Methods

The records for paediatric inpatients from 1 July 1981 to 1 July 1986 that included as the discharge diagnosis diarrhoea or gastroenteritis were examined and the following information was recorded for each child:

- month and year of admission;
- age at admission;
- axillary temperature at admission;
- dehydration status at admission;
- other associated diagnoses;
- quantity of half-strength Darrow's solution used;
- other treatment given for diarrhoeal diseases, including ORS, and antibiotics;
- number of days of hospitalization; and
- outcome of the hospitalization.

The records were examined by a clinical officer who had worked at the hospital during the period covered by the review and who was familiar with the record-keeping practices used. Records that did not
contain all the above-mentioned information were reviewed and the partial data that they contained were noted. Often the quantity of intravenous solution used was not indicated on the records, but if there was a written order for such fluid the amount administered was assumed to be 500 ml, the minimum volume of half-strength Darrow’s solution obtainable from the hospital pharmacy for paediatric use. Although the latter solution is not the treatment of choice for intravenous rehydration, it was the only intravenous therapy for paediatric use that was available.

**Data analysis**

The following information was tabulated for all the children admitted with a discharge diagnosis of diarrhoea or gastroenteritis: the associated diagnosis, if any; age group; male to female ratio; and mean axillary temperature on admission. Means and rates were then calculated for the number of paediatric admissions, hospital practices and the severity of disease. Differences in proportions were tested using $\chi^2$ and Fisher’s exact tests.

**Impact on the number of paediatric admissions**

The proportion of paediatric admissions with a discharge diagnosis that included diarrhoea or gastroenteritis was calculated by 12-month interval and for the 36-month period prior to 1 July 1984 as well as for the 24-month period beginning on 1 July 1984.

**Impact on hospital practices**

The total volume of half-strength Darrow’s solution used for children with diarrhoea and the volume used per child were calculated by 12-month interval as well as for the above-mentioned 36-month and 24-month periods. Also, the proportion of children with mild or moderate dehydration who had received intravenous fluid as one of the treatments, or ORS and no intravenous fluid, was calculated for these same periods.

**Impact on the severity of disease**

The proportions of children with diarrhoea who were admitted with dehydration or severe dehydration were calculated by 12-month interval as well as for the 36-month and 24-month periods. The case fatality rates, incidence of diarrhoeal diseases per 1,000 paediatric admissions, number of days of hospitalization prior to death, and number of days of hospitalization per child with diarrhoea were also calculated for the 36-month and 24-month periods.

**Impact on recurrent costs**

Information on hospital recurrent costs (salaries and other costs, but excluding information on capital costs, which was unavailable) at KCH for 1984 was obtained from the Ministry of Health. The costs of ORS and of half-strength Darrow’s solution were obtained from the Malawi Central Pharmacy. The recurrent hospital costs for each year of the study period were determined by extrapolating from the data for 1984 and adjusting for inflation using a 1985 general price index for Malawi. All costs were expressed in 1984 Malawi kwacha (US$ 1.00 = 1.41 kwacha). Allocation of the total hospital recurrent costs attributable to admissions for diarrhoeal diseases was based on the proportion of total admissions for such diseases among children under 5 years of age.

**Results**

A total of 3495 paediatric inpatients with diarrhoea or gastroenteritis as a discharge diagnosis were admitted to the paediatric ward of KCH from 1 July 1984 to 1 July 1986. Of these children, 2263 (65%) had an associated illness; and 65% of the latter children were diagnosed to have otitis media, measles, malaria, or pneumonia. Altogether, 60% of the children were 12 months of age or less, 26% were 13–24 months, and the remaining 14% were more than 24 months. The male to female ratio was 1.3 for the 3052 children whose sex had been recorded, while for 2864 children the mean axillary temperature on admission was 37.2 °C; 730 (25%) of the latter children had temperatures ≥ 38.0 °C on admission.

From 1 July 1981 to 1 July 1986 the proportion of children with diarrhoea who also had an associated illness is shown in Table 1 (second column), by 12-month interval.

**Impact on the number of hospital admissions**

During the 36 months prior to 1 July 1984, 2548 (14%) of the 18,027 paediatric admissions to KCH had diarrhoea or gastroenteritis as a discharge diagnosis. In contrast, during the 24 months beginning on 1 July 1984, only 947 (7%) of the 14,131 paediatric admissions had a discharge diagnosis of diarrhoeal disease (Table 2). This represents a 50% decrease in the proportion of admissions and is statistically

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Table 1: Treatment practices and outpatient rehydration activities, by 12-month interval, Kamuzu Central Hospital, Malawi, from 1 July 1981 to 30 June 1986

<table>
<thead>
<tr>
<th>12-month interval*</th>
<th>% of diarrhoea cases with associated illness</th>
<th>% of paediatric admissions due to diarrhoea or gastroenteritis</th>
<th>No. of litres of half-strength Darrow's solution per child</th>
<th>% of children with mild or moderate dehydration who were treated with:</th>
<th>% of diarrhoea cases with severe dehydration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981–82</td>
<td>78</td>
<td>21</td>
<td>0.89</td>
<td>11 ORS</td>
<td>84 Intravenous fluid</td>
</tr>
<tr>
<td>1982–83</td>
<td>53</td>
<td>14</td>
<td>1.41</td>
<td>7 ORS</td>
<td>89 Intravenous fluid</td>
</tr>
<tr>
<td>1983–84</td>
<td>62</td>
<td>10</td>
<td>0.93</td>
<td>28 ORS</td>
<td>63 Intravenous fluid</td>
</tr>
<tr>
<td>1984–85</td>
<td>63</td>
<td>8</td>
<td>0.52</td>
<td>61 ORS</td>
<td>28 Intravenous fluid</td>
</tr>
<tr>
<td>1985–86</td>
<td>59</td>
<td>7</td>
<td>0.34</td>
<td>78 ORS</td>
<td>23 Intravenous fluid</td>
</tr>
</tbody>
</table>

* Intervals ran from 1 July of one year to 30 June of the next
ORS=oral rehydration salts; no intravenous fluid was used

Table 2: Treatment practices and outpatient rehydration activities, Kamuzu Central Hospital, Malawi, 1 July 1981 to 30 June 1986

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>% of paediatric admissions due to diarrhoea or gastroenteritis</td>
<td>14</td>
<td>7</td>
<td>-50</td>
</tr>
<tr>
<td>No. of litres of half-strength Darrow’s solution per child</td>
<td>1.13</td>
<td>0.5</td>
<td>-56</td>
</tr>
<tr>
<td>% of children with mild or moderate dehydration treated with ORS*</td>
<td>21</td>
<td>69</td>
<td>+228</td>
</tr>
<tr>
<td>% of children with mild or moderate dehydration treated with intravenous fluid</td>
<td>78</td>
<td>26</td>
<td>-67</td>
</tr>
<tr>
<td>% of children admitted with severe dehydration</td>
<td>10</td>
<td>17</td>
<td>+70</td>
</tr>
<tr>
<td>Case fatality rate for paediatric diseases</td>
<td>9</td>
<td>12</td>
<td>+33</td>
</tr>
<tr>
<td>No. of paediatric deaths from diarrhoeal diseases (per 1000 paediatric admissions)</td>
<td>12.9</td>
<td>7.9</td>
<td>-39</td>
</tr>
<tr>
<td>Recurrent hospital costs attributable to admissions for paediatric diarrhoeal diseases (in kwacha)a</td>
<td>93 894</td>
<td>64 016</td>
<td>-32</td>
</tr>
</tbody>
</table>

* ORS=oral rehydration salts; no intravenous fluid was used.
a US$1.00 = 1.41 kwacha

significant ($P < 0.000001, \chi^2$ test). The rates of diarrhoea or gastroenteritis for paediatric admissions by 12-month interval are shown in Table 1 (third column).

**Impact on hospital practices**

During the 36 months prior to 1 July 1984, 2873 litres (1.13 litres per child) of half-strength Darrow’s solution were used in the paediatric ward for children with diarrhoeal diseases. In contrast, for the 24 months starting on 1 July 1984, 454 litres (0.5 litres per child) were used (Table 2). This represents a 56% reduction in the volume of Darrow’s solution used per child. The volume of solution used per child by 12-month interval from 1 July 1981 to 1 July 1986 is shown in Table 1 (fourth column).

Between 1 July 1981 and 1 July 1984, 1479 children were admitted to KCH with mild or moderate dehydration. Of these, 317 (21%) were treated only with ORS and no intravenous fluid, while 1147 (78%) received intravenous solution, and 15 (1%) were recorded as having received no fluid therapy. A total of 638 children with mild or moderate dehydration were admitted from 1 July 1984 to 1 July 1986; of these, 441 (69%) were treated only with ORS, while 163 (26%) received intravenous solution (Table 2). The proportion of children treated exclusively with intravenous solution over these two periods decreased by 67%, which is statistically significant ($P < 0.000001, \chi^2$ test). The proportions of children who received ORS or intravenous fluid, by 12-month interval, are shown in Table 1 (fifth and sixth columns).
During the study period, antibiotics were used to treat 39 (3%) of the 1232 children admitted to the paediatric ward with diarrhoeal disease as the only discharge diagnosis.

**Impact on the severity of disease**

Of the 2548 children admitted to the paediatric ward at KCH with diarrhoeal diseases in the 36 months prior to 1 July 1984, 1744 (68%) were dehydrated on admission, 265 (10%) with severe dehydration. From 1 July 1984, 865 (91%) of the 947 children admitted with diarrhoea were dehydrated, 165 (17%) severely so (Table 2). The proportion of children admitted with dehydration increased by 34% after 1 July 1984, and is statistically significant ($P<0.000001$, $\chi^2$ test); also, the difference in the proportion of severely dehydrated children increased by 70% and is statistically significant ($P<0.000001$, $\chi^2$ test). The annual rates of severe dehydration are shown in Table 1 (last column).

A total of 234 (9%) of the 2548 children admitted with diarrhoea in the 36 months prior to 1 July 1984 died in the hospital. In the 24 months beginning on 1 July 1984, 113 (12%) of the 911 children admitted died in the hospital. The case fatality rate therefore increased by 33%, and is statistically significant ($P<0.019$, $\chi^2$ test).

The 234 deaths that were associated with diarrhoeal diseases prior to 1 July 1984 correspond to 12.9 per 1000 paediatric admissions, while the 113 deaths beginning on 1 July 1984 represent 7.9 per 1000 paediatric admissions. This difference amounts to a 39% reduction and is statistically significant ($P<0.000002$, $\chi^2$ test).

During the 36 months prior to 1 July 1984, the mean length of hospitalization prior to death for children who died from diarrhoeal diseases was 4.4 days; during the 24 months beginning on 1 July 1984, the mean length was 3.6 days. The mean length of hospitalization for all children admitted with diarrhoeal disease was 4.3 days during the 36 months prior to 1 July 1984 and 4.0 days from 1 July 1984.

**Impact on recurrent costs**

The annual recurrent costs associated with inpatient treatment of diarrhoeal diseases at KCH (staff salaries, medications, and other costs) decreased by 32%, from a yearly average of 93,893 kwacha during the 36-month period prior to 1 July 1984, to a yearly average of 64,016 kwacha, during the 24-month period beginning on 1 July 1984. These savings represent 1.7% of the total annual recurrent costs at KCH.

The cost of half-strength Darrow's solution as a proportion of the total recurrent costs associated with treatment of diarrhoeal diseases at KCH decreased by 67% over the study period, from 3% during the 36 months prior to 1 July 1984 to 1% during the following 24 months.

**Discussion**

The refresher training of paediatric staff at KCH significantly altered treatment practices for children admitted with diarrhoeal diseases to the paediatric ward. The impact of the training on the diagnosis and assessment of dehydration status, however, could not be determined. During a 2-year post-training period, the use of intravenous solution to rehydrate children with diarrhoeal diseases decreased by 56%, the exclusive use of ORS for mild or moderate dehydration increased threefold, and the use of intravenous solution as one of the treatments for mild and moderate dehydration decreased by 67%. Since 1984, when it was removed from the Malawi Central Pharmacy, kaolin has been used only rarely and its use is officially discouraged by the Ministry of Health. Antibiotics are rarely employed to treat uncomplicated diarrhoeal diseases at KCH, where they were prescribed for only 3% of children who had the sole diagnosis of diarrhoeal disease.

At first glance, the 33% increase in the case fatality rate that occurred concurrently with changes in the treatment practices for paediatric patients who had diarrhoeal diseases is a cause for concern. Upon closer examination, however, it appears to have been caused by a change in the proportion of severely dehydrated children admitted to the hospital after the introduction of outpatient ORT activities, and is not the result of the changes in inpatient treatment practices. On an annual basis, the oral rehydration unit treated an average of 2632 children with diarrhoeal diseases during the 24 months beginning on 1 July 1984. Over this period, paediatric admissions for diarrhoeal diseases decreased by 50%, while the proportion of such admissions with severe dehydration increased by 70%. The increased proportion of children with severe dehydration is reflected in the increased case fatality rate and is consistent with the 20-hour decrease in the average time between admission and death; however, the death rate for children with diarrhoeal diseases decreased by 39%. Monitoring of children who are admitted with diarrhoeal diseases at KCH will be continued to ensure that the change in treatment practices is having the desired effect.

The decrease in recurrent costs associated with the changes in treatment and admission practices for paediatric diarrhoeal diseases at KCH represents a small proportion of the total recurrent costs at the hospital. Were they to be made at the national level,
however, such savings would be considerable since diarrhoeal diseases account for 9% of all paediatric admissions to hospitals in Malawi (7).

Savings in recurrent costs may, however, be partly obscured by the replacement morbidity that occurred at KCH, where there was no reduction in the number of paediatric admissions, despite the decrease in those admitted with diarrhoeal diseases. Nevertheless, the changes that occurred in the treatment practices, with a decrease in the proportion of recurrent costs for intravenous solutions, ensured the efficient use of existing resources and led to reallocation of funds to other areas of need.

In Malawi, 86% of children admitted to hospital with diarrhoeal diseases were less than 25 months of age, 65% of children had other associated diseases, including acute respiratory infections and measles, while 25% had an axillary temperature $\geq 38^\circ$C. Diarrhoeal syndromes associated with other childhood diseases are common (8) and preventive programmes for such diseases will further decrease paediatric admissions for diarrhoeal diseases.

More intensive outpatient ORT activities could result in an even greater decrease in admissions of children with mild or moderate dehydration than noted during the 2 years following staff refresher training at KCH. Also, comprehensive primary health care programmes, including community-level ORT, could prevent most of the complications of diarrhoeal diseases that require inpatient or clinic-based outpatient care. Community-level ORT activities are expanding in Malawi at present and their impact will continue to be closely monitored.

Résumé

Réhydratation par voie orale au Malawi: impact sur la gravité de la maladie et sur les admissions à l'hôpital, les pratiques thérapeutiques et les coûts renouvelables

Au cours des 2 premières années ayant suivi la formation d'une équipe de pédiatrie à la thérapie par réhydratation orale et la mise en place d'une unité de réhydratation par voie orale à l'hôpital central de Kamuzu, Lilongwe, au Malawi, on a

enregistré; une diminution de 50% du nombre des enfants admis dans le service de pédiatrie avec un diagnostic de maladie diarrhéique; une baisse de 56% de l'utilisation des liquides intraveineux pour la réhydratation de ces enfants; une augmentation de 70% de l'utilisation des sels de réhydratation orale (SRO) réservés exclusivement à la réhydratation d'enfants atteints de déshydratation légère à modérée; une diminution de 39% du nombre de décès associés aux maladies diarrhéiques. Pendant la même période, on a observé une diminution de 32% des coûts hospitaliers renouvelables imputables aux maladies diarrhéiques de l'enfant. Au Malawi, où les maladies diarrhéiques représentent 9% des admissions en pédiatrie, on devrait observer, au fur et à mesure que la réhydratation orale poursuit sa progression, une diminution considérable de la mortalité par maladies diarrhéiques et une augmentation concomitante des économies budgétaires réalisées dans le traitement des maladies diarrhéiques de l'enfant.

References
