

# The Red Cross Children's Hospital Rehydration Unit – a 50-year review

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Although Red Cross War Memorial Children's Hospital (RCCH) is renowned for its achievements in many branches of specialist paediatrics, one non-specialist service has provided care in extraordinary circumstances for hundreds of thousands of children. The Rehydration Unit for the management and treatment of infantile gastroenteritis (GE) has a 50-year history of adaptation and innovation in changing and demanding circumstances.

## An unexpected beginning

The inpatient wards of RCCH opened for the reception of patients on 18 June 1956. The outpatient department (OPD) followed 2 weeks later. The hospital had been built with a relatively small area for outpatients, as it was intended to be a referral institution. There was neither specific provision for large numbers of self-referred outpatients nor a casualty department. The community thought otherwise, and there was an ever-increasing flow of outpatients to the hospital. In the first 7 months after the opening, 7 709 largely self-referred patients were seen. The commonest diagnosis for admission to the hospital was GE – 81 of the 423 admissions in that half year.

By 1957 the community had really discovered the hospital and OPD numbers soared to 27 666 for the year. One hundred and five deaths were recorded. These were children for whom no beds were available in the hospital or at any other institution in Cape Town. Over 50% of these deaths were of infants with GE. The two medical registrars employed by the hospital were unable to cope with this flow of patients and a third registrar post was created specifically for the OPD (MB). As GE was the single most common cause of morbidity and mortality, it was decided to set up a Rehydration Unit (RU) (also known as the drip room) in the OPD to deal with this problem. A large consulting room was fitted out with facilities for fluid therapy for several infants simultaneously (Fig. 1). Despite the opposition of hospital management, the successor of this original drip room still exists today.

## Increasing needs

The population of Cape Town was increasing rapidly and the popularity of RCCH as a treatment centre followed suit. The converted consulting room soon became too small and early in the 1960s prefabricated extensions, including a larger RU, were added to the OPD block. In the latter half of 1964 a consultant paediatric post was created for the OPD. The appointee (MB) lobbied for a further extension to the OPD, for a more spacious RU, for an attached but separate 'oral fluids only' facility and for an inpatient ward for persistent GE cases. Infants with



Fig. 5. Resuscitation room for out-patients at the Red Cross War Memorial Children's Hospital, showing couches with overhead beams for intravenous drip sets.

Fig. 1. The first Drip Room (reproduced from Bowie<sup>1</sup>).

persistent diarrhoea were difficult to handle in the RU as, in summer peak period there were sometimes 90 admissions a day. The first two of these improvements were introduced at the end of the 1960s.

By 1973 another larger RU in a further prefabricated extension to the OPD became fully operational. The unit consisted of a large area equipped with multiple foam-covered benches and attachments from which drips could be suspended. Chairs were provided for the mothers or caregivers. They were responsible for care of their children and were actively involved in treatment. This in itself had educational value and emphasised to parents the pivotal role of fluid replacement in the treatment of GE. A separate room was provided where they could take a break during the long hours of rehydration. Infants who had been rehydrated were often moved to this facility in the care of their mothers to be fed by bottle or teaspoon before discharge. It was notably rare to have a breastfed infant admitted to the unit. The increased space led

to more organised and consistent treatment, the use of flow chart systems and a policy of early discharge. There was an apparent reduction in cross infection.

Through the 1970s and into the 1980s the summer peak of diarrhoea cases continued to strain the resources of the RU, with high occupancies and difficulty transferring deserving cases to inpatient facilities in the RCCH or elsewhere. Fig. 2 shows a typical year's admissions to the RU. Despite increasing numbers of patients (Fig. 3), no further physical expansion took place until construction of the new OPD building in 2000 (Fig. 4).

### Innovation and research

Looking back it is clear that these challenging years produced a fertile confluence of innovation and research that has provided much of the basis for management of dehydrating diarrhoea in South Africa. Early on, the very large numbers of dehydrated infants presenting to the hospital dictated that this problem could not be handled by conventional outpatient diagnosis and inpatient admission for management and treatment. The effort had to be made to devise a scheme of treatment for these patients in the OPD in as simple and effective a manner as possible. This mass of patients would have to be treated as a primary health care problem. The setting up of the RU was in effect the first step in attempting to answer this problem and was detailed in an article in the *South African Medical Journal* in 1960.<sup>1</sup>

Research was initially directed at identifying and recording major problems such as the severe malnutrition seen in many children. In the 1950s most of these infants could have been

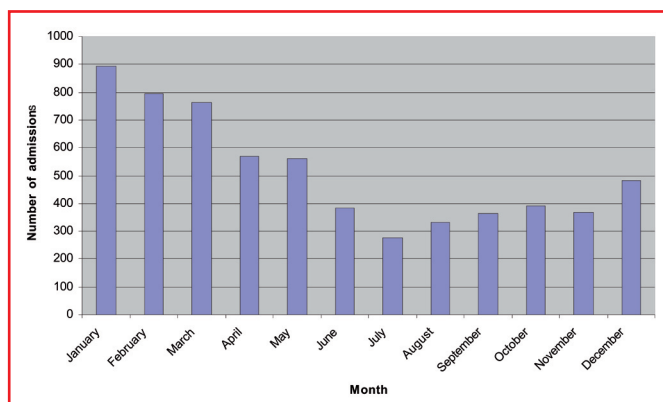


Fig. 2. Monthly admissions to the Rehydration Unit in 1988.

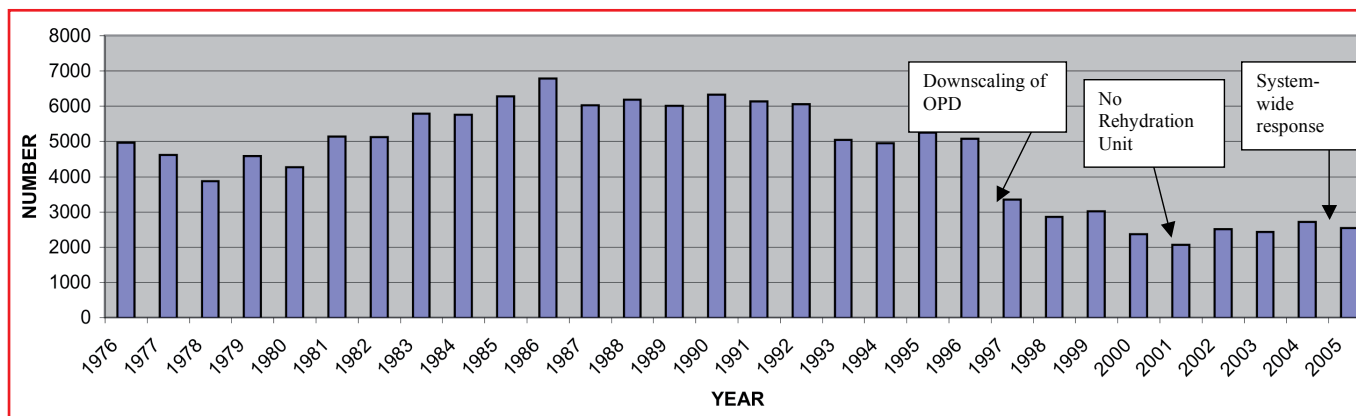


Fig. 3. Annual admissions to the Rehydration Unit 1976 - 2005.

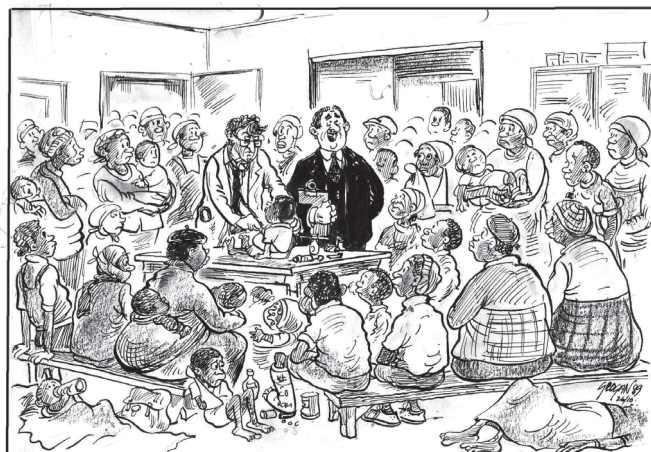


Fig. 4. Cartoonist Tony Grogan's solution to an overcrowded outpatient department.

classified as having marasmus or marasmic kwashiorkor. Fig. 4 from the 1960 article<sup>1</sup> (reproduced here as Fig. 5) shows how far below the third percentile the average weight-for-

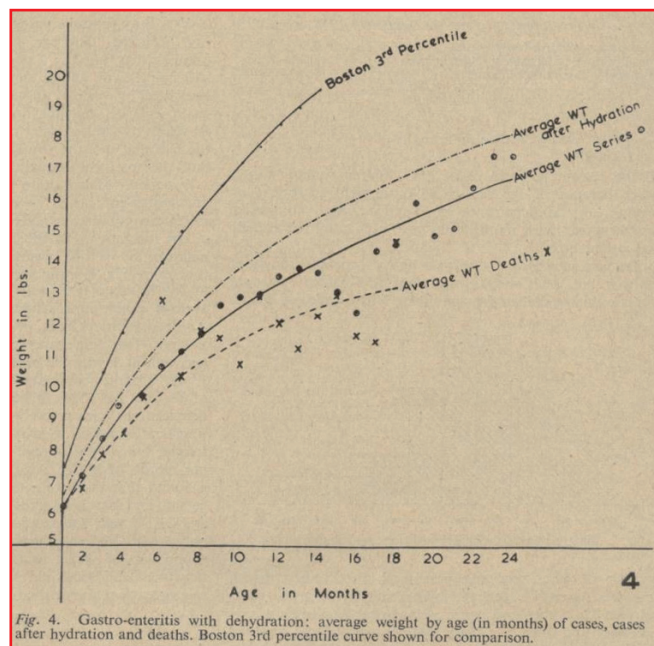


Fig. 4. Gastro-enteritis with dehydration: average weight by age (in months) of cases, cases after hydration and deaths. Boston 3rd percentile curve shown for comparison.

Fig. 5. Malnutrition, diarrhoea and death in the 1950s (reproduced from Bowie<sup>1</sup>).

age of children was at that time. It also demonstrates the relationship between mortality from GE and the severity of malnutrition. Over the years the nutritional status of the patients improved, but a high incidence of underweight-for-age infants remains to this day. An unpublished audit of admissions to the RU in 2002 showed that there were nutritional concerns in nearly half of the children. The poor nutritional status of the infants has been responsible for our policy of refeeding as soon as possible and avoiding prolonged periods on intravenous fluids or oral 'clear' fluids.

The basis of treatment was and remains the replacement of fluid and its contents lost through diarrhoea and vomiting. Stool losses of water, sodium, chloride, fat, and potassium had been demonstrated many years previously, and sodium and glucose replacement were established therapy. In 1946 Govan and Darrow<sup>2</sup> and Darrow<sup>3</sup> showed that potassium could be safely added to intravenous fluids and that this reduced mortality from 32% to 6%. This work was the stimulus for developing a half-strength Darrow's solution as the sole rehydration fluid in the RU. This was a considerable simplification of the complicated regimens then in use elsewhere, and one that over the years has proved to be safe and successful. Subsequently a trial was undertaken to compare oral fluid therapy using the same half-strength Darrow's with intravenous fluids.<sup>4</sup> In the majority of cases the oral and nasogastric fluids were as effective as the intravenous fluids.<sup>4</sup> This further simplification of treatment that came about in the early 1970s would, it was hoped, encourage the use of RUs in the community. A leaflet of protocols for fluid and electrolyte management as well as co-morbidities such as malnutrition formed the basis of treatments used in the RU from that time.

The policy of early feeding worked well in the majority of cases, but in some instances severe diarrhoea persisted and appeared in part to be due to the return to oral milk feeds. Previous work from the RCCH had demonstrated acquired lactose malabsorption as a complication of protein energy malnutrition.<sup>5</sup> In a study of infants with severe persistent diarrhoea about 50% promptly responded to a change of intake from a cow's-milk-based feed (lactose) to a soya-based formula (sucrose).<sup>6</sup> This improvement appeared to be due to the elimination of lactose from the diet. There remained a significant number of infants who did not respond to the dietary manipulation. Subsequently it was found that if the feed change was ineffective, giving gentamicin, cholestyramine and metronidazole for a short period almost invariably resulted in a cessation of the diarrhoea.<sup>7</sup> This so-called bowel cocktail was later modified by the omission of metronidazole and the substitution of neomycin for the more expensive gentamicin. This change did not make this method of treatment less effective.<sup>8</sup> The pathogenesis of the ongoing diarrhoea is not entirely clear but bacterial overgrowth appears to be involved and this is supported by the rapid response to treatment.

Other research was directed at problems that arose during treatment in a more limited number of patients. The metabolic acidosis accompanying dehydration was examined and treatment modified.<sup>9</sup> Hypernatraemic dehydration was extensively studied and a better understanding of its aetiology derived.<sup>10</sup> The enteropathogens involved in the causation of



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GE were studied on several occasions and the higher incidence of bacterial pathogens noted compared with series from developed countries.<sup>11</sup> The development of a 'home made' oral rehydration fluid was undertaken in the RU and proved to be of value in the community.<sup>12,13</sup> In the 1980s, the use of loperamide in controlling diarrhoea was also investigated, but although it was effective in reducing stool volume the occurrence of disturbing side-effects in a number of infants led to its not being recommended.<sup>14</sup>

Another favourable innovation in the early 1970s was the advent of the Advanced Paediatric Clinical Nurse (APCN). A 1-year course to train paediatric nurses in additional clinical skills had been set up and proved highly successful.<sup>15</sup> Some of these trainees were assigned to the RU and rapidly proved their worth, bringing skills and clinical expertise in the handling of infant diarrhoea equivalent to those of a paediatric registrar. Their presence was a contributory factor to the decline in mortality that occurred in the RU.

The APCNs also staffed the inpatient GE ward that opened in 1979. This was intended for the treatment of infants with persistent GE and it proved to be a highly successful unit. In the first year of its existence 218 infants with persistent diarrhoea were treated. Only 3 deaths occurred.

Right through to the present the RU has remained a site for research, including recent studies of electrolyte disorders and their clinical correlates, and treatments for diarrhoea in HIV-infected children.

## Reduction in gastroenteritis mortality — a success story

One of the major achievements of the RU was the reduction in GE mortality. At its inception, the RU had a 9.5% (97/1 024) OPD mortality in dehydrated children in the late 1950s.<sup>1</sup> Through the 1960s the number of deaths in the OPD increased, but the proportion per attendance dropped. In the 1970s, the absolute number of deaths in the OPD started to decrease. In 1970, 314 deaths occurred, but by 1973 this had decreased to 250. GE still accounted for roughly half of these deaths. A diminution of severity of illness and malnutrition among children presenting to the hospital contributed to this decrease, but the protocols of streamlined OPD management and the APCNs prevented many deaths. These trends continued and by 1977 only 57 of the 165 906 children attending the OPD died. By the early 1980s there was less than 1 death among the average of 500 cases treated in the RU each month, attesting to the success of treatment strategies in the Unit.

## The late 1980s and 1990s — a changing environment

In the late 1980s and early 1990s a number of initiatives aimed at establishing RUs with the capacity for nasogastric and intravenous rehydration at community health centres on the Cape Flats involved RU staff in planning and training. Unfortunately none of these units proved sustainable (the reasons for this would make for a valuable case study), and the RU remained the site at which almost all children with GE

from a large area of Cape Town received such treatment. The patients now largely came from Xhosa-speaking families.

In the mid-1990s, the Ambulatory Paediatric Department took over management of the ward from the Gastroenterology Department that had been formed to cover the RU, the GE ward and other services. Fig. 3 indicates the effect on admissions to the RU of the transfer of much of the primary-level first contact OPD service to community clinics that was initiated at that time. Patients with GE received oral rehydration at these sites. Only those deemed to have complications or requiring nasogastric or intravenous therapy would be referred to the RCCH RU.

While patient numbers in the RU dropped considerably, a number of factors contributed to continued pressure. Owing to lack of support for and recognition of their place in the clinical system, the APCNs either left or gravitated into administrative positions as a means of promotion, thereby reducing the efficiency of the RU as inexperienced junior doctors took the front line of care; HIV started to have an impact, lengthening hospital stays and adding to the complexity of patient condition in the RU; and the inpatient GE ward was closed in the mid-1990s as part of major bed cuts in the Western Cape.

Epidemiologically a change took place in the busy summer season during this period. In the 1980s the peak month for admissions to the RU was December, peaking at 1 003 admissions in January 1986. In the 1990s March became the peak month, as it had been in the 1950s. The reason for this shift is unknown but it added to difficulties in the OPD as the diarrhoea season now overlapped with the start of the autumn bronchiolitis season.

## The new millennium — a new paradigm?

During this period a long-prepared plan for a new outpatient building for the RCCH turned into a real brick building in 2000. It was designed without a RU as patients with dehydration from diarrhoea were deemed to require primary level care (although it was not clear where they would receive it!). A rearguard action initiated by one of the APCNs who was now the hospital Matron led to last-minute planning of a new RU that retained many features of the original prefabricated RU. Patients were accommodated in passages in a mercifully light 2001 diarrhoea season (Fig. 3).

From the year 2000 the expanding indigent population of Cape Town, the growing HIV epidemic, and the financial 'imperative' to close beds in hospitals throughout Cape Town led to yearly increments in patient numbers in the RU and a recrudescence in mortality from GE. Fifty per cent of patients now had at least one health problem in addition to dehydrating diarrhoea. The commonest of these were HIV exposure or infection, malnutrition and tuberculosis, all of which increased morbidity and the workload for staff.

In 2004, after an advocacy and information campaign spearheaded by RU staff, the provincial Department of Health initiated a process that led to the RU being seen as part of a complete system of child health. As a consequence of this vision a 'system-wide' response to GE in Cape Town was instituted

incorporating provision of water and sanitation, especially in informal settlements, health promotion (hygiene, recognition of danger signs, sugar-salt solution), expansion of primary health care level services for children after hours, streamlining of referral and transport systems, revitalisation of GE protocols to promote efficiency in the RU, and commissioning of new beds for paediatric patients at many sites. Modest gains were recorded in 2005 (Fig. 3).

Fifty years ago the poorer communities of Cape Town flocked to the RCCH for treatment of GE, finding a service they did not find elsewhere. The hospital offered an increasingly effective response to this need in terms of mortality and morbidity, but was never able to respond fully in terms of overcrowding and parent comfort. Although there was a perception that these patients were at the 'wrong level' of the health system, until very recently (50 years later!) no sustained response to this beyond the hospital was forthcoming. It is perhaps of some consolation that while some patients and parents suffered from the overcrowded conditions, their concentration on one site led to and facilitated innovation and research that has benefited children with diarrhoea in this and many other countries. The RU can lay claim to having saved more children's lives than any other service offered by the RCCH. We should now look towards a system-wide service for children with GE that builds on the RCCH RU successes and avoids its shortcomings.

## References

1. Bowie MD. The management of gastro-enteritis with dehydration in outpatients. *S Afr Med J* 1960; 34: 344-348.
2. Govan CD, Darrow DC. The use of potassium in the treatment of dehydration from diarrhoea in infants. *J Pediatr* 1946; 28: 541-549.
3. Darrow DC. The retention of electrolytes during recovery from severe dehydration due to diarrhoea. *J Pediatr* 1946; 28: 515-540.
4. Motala C, Macdonald WBG, Hill ID, Mann MD, Bowie MD. Comparative evaluation of intravenous versus oral fluid therapy for acute dehydrating infantile diarrhoea. *S Afr Med J* 1986; 70: 51.
5. Bowie MD, Brinkman GL, Hansen JDL. Acquired disaccharide intolerance in malnutrition. *J Pediatr* 1965; 66: 1083-1091.
6. Bowie MD, Hill ID, Mann MD. Response of severe infantile diarrhoea to soya based feeds. *S Afr Med J* 1988; 73: 543-545.
7. Hill ID, Mann MD, Househam KC, Bowie MD. The use of oral gentamicin, metronidazole and cholestyramine in the treatment of severe persistent diarrhoea in infants. *Pediatrics* 1986; 77: 477-481.
8. Bowie MD, Hill ID. Management of persistent diarrhoea in infants. *Indian J Pediatr* 1987; 54: 475-480.
9. Harrison VC, Heese HdeV, Bowie MD, Rubin R. The rapid correction of metabolic acidosis in severely dehydrated infants. *S Afr Med J* 1967; 41: 1041-1044.
10. Hill ID, Mann MD, Bowie MD. Hypernatraemic dehydration. *S Afr Med J* 1981; 59: 479-481.
11. Househam KC, Mann MD, Bowie MD. Enteropathogens associated with acute infantile diarrhoea in Cape Town. *S Afr Med J* 1988; 72: 83-87.
12. Buccimazza SS, Hill ID, Kibel MA, Bowie MD. The composition of home-made sugar/salt solutions for treating gastro-enteritis. *S Afr Med J* 1986; 70: 728-730.
13. Hill ID, Mann MD, Bowie MD. Loperamide for treatment of acute diarrhoea in infants and young children. A double-blind placebo-controlled trial. *S Afr Med J* 1995; 85: 885-887.
14. Bowie MD, Hill ID. Oral rehydration therapy - South African Paediatric Association recommendations. *S Afr Med J* 1989; 76: 461-462.
15. Ireland JD. The training and utilisation of the paediatric clinical nurse in southern Africa. MD thesis, University of Cape Town, 1982.