

Brief Report: Intravenous fluid prescribing and complications in children in UK and Ireland

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Short title: Fluid prescribing and complications

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In recent years, guidance for maintenance intravenous fluid prescribing in children has changed to recommend isotonic solutions in response to compelling evidence(1, 2). Recommendations on maintenance fluid rate and volume have not changed for decades. We assessed the adoption of current guidance and its impact via a national survey.

We undertook a national survey of intravenous fluid use and complications in children greater than 28 days age in 31 hospitals via the General and Adolescent Paediatric Research network in the UK and Ireland (GAPRUKI). The survey evaluated current intravenous fluid prescribing practice and related clinical complications in 20 District General Hospitals and 11 Tertiary Referral Units (table 1). Data was returned by paediatric consultants from 25 centres, specialty training doctors from five, and Advanced Nurse Practitioners from 2 centres.

Results of the survey confirmed that administration of intravenous fluid is common in UK paediatric practice, with 39% of hospitals reporting intravenous fluid use in over 10% of children admitted to paediatric wards.

Isotonic maintenance fluid is now predominantly prescribed in UK paediatric practice. Sodium chloride 0.9% +/- 5% glucose is routinely used in 77% of hospitals, and PlasmaLyte-148 in 16% of centres surveyed. Hypotonic fluid is still used in 7% of hospitals in routine care, mostly 0.45% sodium chloride +/- 5% glucose.

Maintenance fluid is prescribed at traditional Holliday-Segar rates for children (100ml/kg body weight for the first 10kg, 50ml/kg for second 10kg, 20ml/kg for remaining kg per 24 hour period) in 97% hospitals(3). This is consistent with national guidance(2). Different maintenance fluid rates (2/3 Holliday-Segar rates) were reported in just 3% of hospitals.

Electrolyte imbalance in children receiving intravenous maintenance fluid is observed regularly in 77% of hospitals. Forty-two per cent reported electrolyte disturbances that require clinical intervention. Metabolic acidosis complicating fluid maintenance administration was observed in 29% of hospitals surveyed. Pulmonary and cerebral oedema were reported with intravenous maintenance fluid in 13% and 10% centres, respectively.

This national survey confirms that in UK paediatric practice, maintenance intravenous fluid volume rates, but not fluid composition, are based on Holliday-Segar calculations(3). Related complications are commonly reported, including clinically significant electrolyte imbalance and metabolic acidosis, with occasional pulmonary oedema.

In 1957, Holliday and Segar published recommendations for intravenous maintenance fluid prescribing in children. These were based on meticulous experiments with neonates and children and calculations estimating maintenance energy, electrolyte and water requirements for those not receiving enteral fluid or nutrition. They have been widely adopted in paediatric clinical practice and used almost universally for maintenance of intravenous fluid prescription in children for decades.

In recent years, most paediatricians have moved away from prescribing hypotonic fluid due to complications of acute hyponatraemia, evidence that isotonic solutions mitigate this risk, and changes to national guidance(1, 2, 4). Despite this practice change, studies consistently demonstrate the persistence of complications such as hyponatraemia(1, 5). This is because many children in hospitals are subject to non-osmotic stimuli for vasopressin secretion and are therefore at risk of clinically significant fluid overload and hyponatraemia even with isotonic fluid.

These survey data are limited by professionals' recall of their current clinical practice and complications, and therefore warrant robust confirmation with a prospective study.

Notwithstanding its limitations, this survey of UK practice highlights the persistence of complications despite widespread adoption of isotonic fluids, consistent with international experience(5). Clinical trials are urgently required to determine if alternative maintenance fluid rates can improve paediatric care.

Acknowledgments

All research at Great Ormond Street Hospital NHS Foundation Trust and UCL Great Ormond Street Institute of Child Health is made possible by the NIHR Great Ormond Street Hospital Biomedical Research Centre. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

Conflict of Interest Statement

All authors contributed to the study design and final manuscript; none declared any conflict of interest.

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Table

Table 1: GAPRUKI national intravenous fluid survey questions

<p>What intravenous fluid is standard maintenance for children (excluding neonates) in your hospital</p> <ul style="list-style-type: none"> a. 0.9% sodium chloride (+/- glucose) b. 0.45% sodium chloride +/- glucose c. Hartmann's solution d. PlasmaLyte-148 (+/- glucose) e. 10% glucose f. Other (please specify)
<p>For what proportion of children admitted to hospital do you estimate IV fluid is prescribed?</p> <ul style="list-style-type: none"> a. <1% b. 1 - 5% c. 5 – 10% d. 10 – 20% e. >20% f. unsure
<p>What maintenance rate is prescribed for children (excluding neonates):</p> <ul style="list-style-type: none"> g. 100ml/kg for first 10kg, 50ml/kg for second 10kg, 20ml/kg for remaining kg per 24 hour period h. Other (please specify):
<p>What complications do you think children under your care have experienced from the use of maintenance fluid?</p> <ul style="list-style-type: none"> i. Electrolyte imbalance (e.g. hyponatraemia, hyperkalaemia) <ul style="list-style-type: none"> i. Clinically significant (requiring additional management/repeat testing) <ul style="list-style-type: none"> 1. Often/sometimes/rarely/never ii. Mild, not requiring action <ul style="list-style-type: none"> 1. Often/sometimes/rarely/never j. Metabolic acidosis <ul style="list-style-type: none"> 1. Often/sometimes/rarely/never k. Pulmonary oedema <ul style="list-style-type: none"> 1. Often/sometimes/rarely/never l. Cerebral oedema <ul style="list-style-type: none"> 1. Often/sometimes/rarely/never <p>Other (please specify)</p>
<p>Which of the following best describes your clinical role:</p> <ul style="list-style-type: none"> a. General paediatrician b. Training doctor c. Clinical nurse specialist/ Advanced nurse practitioner d. Pharmacist e. Physician Assistant
<p>Which of the following best describes your primary working environment:</p> <ul style="list-style-type: none"> a. District General Hospital b. Tertiary Children's Hospital c. Other (please specify)

