



The Canadian Paediatric Society integrates RealObjects PDFreactor®

The Canadian Paediatric Society (CPS) publishes position statements that convey the opinion and recommendations of the Society. They provide guidance to health care practitioners and policy makers on issues relevant to the health and well-being of Canadian children and youth. The CPS also publishes practice points, which are aimed at paediatricians, family physicians and other child health care providers and discuss specific issues of clinical care.

Statements are published in abstract format in our medical journal *Paediatrics & Child Health*, and in full-length html at www.cps.ca. A printable, professionally-designed PDF is then created from the HTML in real time from a server using PDFreactor® and can be downloaded.

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About the Canadian Paediatric Society

The CPS is the national association of paediatricians, committed to working together to advance the health of children and youth by nurturing excellence in health care, advocacy, education, research and support of its membership. As a voluntary professional association, the CPS represents more than 3,000 Canadian paediatricians, paediatric subspecialists, paediatric residents, and other people who work with and care for children and youth. The CPS is governed by an elected Board of Directors representing all provinces and territories.

The CPS is active in several major areas:

Professional education: The CPS supports the continuing professional development needs of paediatricians and others involved in providing health care to children and youth through position statements, a peer-review journal, and educational opportunities.

Advocacy: The CPS identifies gaps in and encourages improvements to public policy that affects the health of children and youth.

Public education: The CPS works to increase public awareness and education about the health needs and health care of children and youth.

Surveillance and research: The CPS monitors rare diseases and conditions through the Canadian Paediatric Surveillance Program, and ensures continued research into vaccine-associated adverse reactions and vaccine-preventable diseases through IMPACT (Immunization Monitoring Program, ACTIVE).

Problem

Every month, the CPS publishes position statements that convey the opinion and recommendations of the Society. They provide guidance to health care practitioners and policy makers on issues relevant to the health and well-being of Canadian children and youth. The CPS also publishes practice points, which are aimed at paediatricians, family physicians and other child health care providers and discuss specific issues of clinical care.

Statements are published in abstract format in our peer-reviewed medical journal [Paediatrics & Child Health](#), and in [full-length html](#) at www.cps.ca. Many of our core audiences require a printer-friendly, journal quality full-length version of these documents. Traditionally PDF files were provided by the journal's publisher, but since moving to publishing the abstract version only, the full length documents have only been available in HTML.

At the same time, the organization was interested in updating the standard design for the printer-friendly PDF versions to make the elements consistent across all documents.

The CPS is a non-profit organization. With a repository of more than 360 documents (statements and practice points in English and French) the cost of manually updating the design for each document was cost prohibitive.

Why RealObjects PDFreactor®?

Moving forward the CPS was looking for a solution that would convert these documents from HTML to PDF dynamically and in real-time to accommodate any ongoing revisions and updates to the HTML version. The solution had to be easily integrated into our existing publishing structure, provide consistent design across all documents and reduce long-term costs. We did evaluate other PDF solutions, but came to the conclusion that PDFreactor® was the most efficient and cost-effective solution.

With RealObjects PDFreactor® we were able to capitalize on our existing web processes by defining page layout and styles using Cascading Style Sheets (CSS). The tool delivers fast, reliable, high-quality journal-like documents that our audiences can easily download and print.

Realization of objective

It was critical to the integrity of the documents that only one canonical version existed of each, in the master document database. This would ensure that all consumers of the document would pull from a single source, and the document would be transformed in real time to suit the display mechanism. This has the added advantage that staff time will not be required to create and manage, indefinitely, both printed and electronic versions of a document in two official languages. Keeping all the content unified in the document management system is superior to splitting it between the database and the file system (for the PDFs). It greatly simplifies the process of updating and revising documents.

CPS already had their re-engineered website fully integrated with the document database which provided attractively styled renderings of the documents in HTML. The only thing missing was to provide a print-ready version of the documents as well.

The documents database was modified to accept requests for a given paper in a given language, and to identify and pass the correct paper and the correct styles to PDFreactor®, which then passes the fully rendered PDF back. A mechanism was also added to store this PDF in a cache, so that PDFreactor® did not need to be accessed each and every time a PDF was required. Any changes to the document result in the cache being invalidated, and a new PDF being stored at the next request. This means that, essentially, any change to a document is reflected on the website and the PDF version in a matter of moments. Everything is automatic and seamless. In the past, this process would have required a new PDF to be created and uploaded to the server, a time consuming process when all of the different steps and staff involved are taken into account.

This process is entirely transparent to the user, who is unaware of the connections between the website, the documents database, and PDFreactor®. All they know is that when they click the Print-Ready button, they are provided almost instantly with an extremely high-quality, fully paginated, professional version of the document.

PRACTICE POINT

Risk of acute hyponatremia in hospitalized children and youth receiving maintenance intravenous fluids

Jeremy N Friedman, Canadian Paediatric Society Acute Care Committee
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Abstract

Hyponatremic acute hyponatremia is increasingly recognized as a cause of morbidity and mortality in children. It has been attributed primarily to the use of hypotonic intravenous (IV) fluids to maintain fluid and electrolyte requirements. This practice point outlines current understanding of the problem and summarizes recent research dealing with this issue. Updated recommendations are made for the prescription of IV maintenance fluids in children between one month and 18 years of age. The use of isotonic fluid (D5W/0.9% NaCl) is recommended in most circumstances. Hypotonic IV fluids containing less than 0.4% NaCl should not be used to provide routine IV fluid maintenance requirements.

Key Words: Acute hyponatremia; Intravenous fluid prescription; Maintenance intravenous fluids

The problem

Hyponatremia, defined as a serum sodium (Na) <135 mmol/L, has become increasingly recognized as a cause of morbidity and mortality in hospitalized children.¹⁻¹⁰ In recent years there have been many reports of serious morbidity, including severe neurological injury, as well as many deaths among children who developed hyponatremia while receiving IV fluids.¹⁰⁻¹⁷ A case-control study reported that 40% of 412 (9%) of hospitalized children on IV fluids who had a normal baseline serum Na had a subsequent serum Na <136 mmol/L.¹⁵ Other studies have shown an incidence of hyponatremia in hospitalized children as high as 24%.¹⁸

Hyponatremia has been attributed primarily to the use of hypotonic maintenance IV fluids. The administration of such fluids provides a source of electrolyte-free water (EFW) to a population of children who are at risk for increased antidiuretic hormone (ADH) secretion.^{19,20} Clinical sequelae of acute hyponatremia (to decrease in Na over 448 h) result from acute cerebral edema, and may include headache, lethargy

and seizures, and potentially even respiratory and cardiac arrest secondary to brain stem herniation. These outcomes are more likely to be seen with severe acute hyponatremia (Na <120 mmol/L). Because of their higher brain/intracranial volume ratios, children are at increased risk for these sequelae compared with adults.

The routine practice of providing hypotonic maintenance IV solutions, usually containing 20 mmol/L to 30 mmol/L of Na, is based on Holliday and Segar's seminal paper published in 1957²¹ and translates to the use of 0.2% NaCl/dextrose 5%. These recommendations were based on caloric expenditure in healthy children, and electrolyte composition was derived from that of human and cow's milk.

It has been recognized that the great majority of hospitalized children are at risk of neurophysiological antidiuretic hormone (ADH) secretion – due to nausea, stress, pain, pulmonary and central nervous system disorders, surgical interventions, and commonly used medications such as morphine sulfate – which implies that Holliday and Segar's traditional recommendations for administering hypotonic IV fluids are probably inappropriate. The high percentage of EFW in hypotonic IV fluids (78% EFW) compared with normal saline (0% EFW), in combination with an impaired ability to excrete water as a result of ADH secretion, places hospitalized children at increased risk of developing acute hyponatremia.

IV fluid prescription practices for children vary widely among physicians both within and between hospitals. A cross-sectional survey carried out in multiple hospitals in the United Kingdom revealed that 77 of 99 children receiving IV fluids during one day of a specified week were receiving hypotonic solutions. Twenty-one of the 86 children (24%) who had serum electrolytes measured were found to be hyponatremic, and the vast majority of these were receiving hypotonic IV fluids.¹⁹

To avoid the development of acute hyponatremia, it has been recommended that isotonic 0.9% NaCl/dextrose 5% (normal

TABLE 3
Intravenous (IV) fluid maintenance recommendations based on plasma Na+ level

Children one month – 18 years of age	Recommended IV fluid
Na <135 mmol/L	Isotonic IV solutions
Na 135 mmol/L – 144 mmol/L	Isotonic IV solutions preferred; half isotonic solutions may be used
Postoperative period	Isotonic IV solutions

Acknowledgements

This practice point has been reviewed by the Canadian Paediatric Society's Community Pediatrics Committee.

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When the CPS decided to use HTML to PDF conversion, it quickly became obvious that the organization didn't have the internal expertise available to make the best use of the CSS 3 page layout and automatic pagination capabilities. With that in mind, the CPS contracted the RealObjects design team to produce the final style sheet that would dynamically render:

- A standard header and footer
- Two column and single column images
- Four levels of sub-heads
- At least two different font sizes
- Two column layout
- Appropriate page and text breaks
- Two column and single column tables
- Bulleted and numbered lists

Conclusion

PDFreactor® was formally and successfully implemented after the software was tested across a variety of different types of documents. The main advantages in using this software included:

- A completed style sheet was immediately applied to all 360 documents.
- The ability to update and revise the style sheet moving forward and to integrate the revisions across all documents.
- The ability to streamline the work flow into an existing publication process.

“PDFreactor® is incredibly versatile and was very straightforward to integrate into CPS’s existing Ruby on Rails document management system. The PDF Reactor team was able to provide extremely quick turnaround on support questions. Between their CSS experts and the software itself, RealObjects has allowed CPS to produce output with surprising visual complexity and polish.”

Ross Barclay, Ruby on Rails Developer, Toronto Ontario

Overall the RealObjects support team was responsive, professional and tremendously easy to work with.

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