WORKSHEET for Evidence-Based Review of Science for First Aid

Clinical question.

General: In hypohydrated individuals, do carbohydrate-electrolyte drinks compared to water rehydrate an individual?

PICO Format: In hypohydrated individuals (P) does providing fluids (I) as compared to providing no fluids (C) decrease symptoms (O)? In hypohydrated individuals (P) does a carbohydrate-electrolyte beverage (I) compared to water (C) rehydrate individuals (O)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention

State if this is a proposed new topic or revision of existing worksheet: New Topic

Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? Yes, Intellectual interest

Search strategy (including electronic databases searched).

Cochrane Reviews, DARE, and CENTRAL: “hypohydrated” OR “dehydrated” OR “fluid loss” AND “treatment” OR “rehydration” OR “drinking” OR “fluid replacement” as text words in abstract field. Additional terms used were “water” OR “carbohydrate electrolyte beverage” OR “sport drink”

Medline, PubMed, PubMed Central, CINAHL, and Pre CINAHL: same search terms as above

MESH Terms:
Fluid Therapy*/adverse effects
Gastroenteritis*/therapy
Rehydration Solutions*/standards
Rehydration Solutions*/therapeutic use
Rest/*/physiology
Body Fluids/physiology
Beverages*
Drinking Behavior*
Water-Electrolyte Balance*
Dehydration*/therapy
Dietary Carbohydrates*/administration & dosage
Glucose*/administration & dosage
Administration, Oral

State inclusion and exclusion criteria

Inclusionary items: dehydration, hypohydration, or fluid loss due to exercise, being in warm environments, and common illnesses (gastroenteritis).

Exclusionary items: special populations and diseases (i.e. cystic fibrosis, multiple sclerosis, musculoskeletal diseases, cholera, malaria, cancer), animals, pregnancy, infants, and beverages not available to the lay rescuer

Number of articles/sources meeting criteria for further review:

20 articles currently meet criteria for review. Of these, 3 were LOE 1, 12 were LOE 2, and 5 was LOE 3.
## Summary of evidence

### Evidence Supporting Clinical Question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<td>Poor</td>
<td>1</td>
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### Level of evidence

- **A** = Successful rehydration via oral solution
- **B** = Successful rehydration via NaCl beverage
- **C** = Successful rehydration via Carbohydrate beverage
- **D** = Successful rehydration via water
## Evidence Neutral to Clinical question

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<tr>
<td>Fair</td>
<td>Wong, 2000 ABC</td>
<td>Gonzalez, 1992 ABCD</td>
<td>Evans, 2009 ABC</td>
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<td>Poor</td>
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### Level of evidence

A = Successful rehydration via oral solution  
B = Successful rehydration via NaCl beverage  
C = Successful rehydration via Carbohydrate beverage  
D = Successful rehydration via water

## Evidence Opposing Clinical Question

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### Level of evidence

A = Successful rehydration via oral solution  
B = Successful rehydration via NaCl beverage  
C = Successful rehydration via Carbohydrate beverage  
D = Successful rehydration via water
There is a solid foundation of research exploring “sports drinks” or carbohydrate electrolyte beverages (CEB) in the literature but not as many that actually compare CEB directly to water. Instead the research focuses upon different formulations of carbohydrate and NaCl to optimize rehydration. Measures of “successful rehydration” were: increased fluid intake, plasma volume expansion, decreased urine output (conservation of fluids), and return to baseline body mass. Overall, the research showed optimal successful rehydration in CEBs with higher levels of carbohydrate and NaCl- which can be found in some commercially made CEBs. The key component of the CEB being the NaCl level due to the simple fact that water follows NaCl. Therefore, if you increase NaCl, the more water will be retained in the body.

Studies that have compared CEB directly to water still support the use of water as a rehydration beverage however have shown benefits to using the CEB over water. Ingestion of plain water can result in the decrease in plasma NaCl and therefore osmolality. These changes result in reducing voluntary fluid intake and stimulate increased urine output- both of which will delay complete rehydration(Shirreffs 1998;868, Nose 1988;332, Gonzalez-Alonso1992;399, Greenleaf 1998; 837, Shirreffs 2007;1899). With CEBs, the amount of NaCl is inversely related to urine output- the more NaCl the less urine output(Shirreffs 1998, Maughan 1995, Merson 2008). This means more of the CEB is retained in the body to help return the individual to euhydration. (Of note: sodas, juices, and alcohol contain no NaCl and therefore should not be used for rehydration as well as for other reasons). Research shows that carbohydrate by itself doesn’t necessarily optimize rehydration but instead replaces glucose levels within the body. However, the carbohydrate does make the NaCl more palatable and increases voluntary fluid intake (Greenleaf 1998, Evans 2009 Shirreffs 2007). Little is known about the role of other electrolytes in the rehydration process and therefore may not be a concern to the lay rescuer till more is known.

A significant amount of research has been done on oral rehydration versus intravenous administration (Castellani 1997, Kenefick 2000, Kenefick 1899, Kenefick 2006, Riebe 1997). Even though a lay rescuer cannot perform IV administration, this research supports encouraging the lay rescuer to use oral rehydration with treating someone with dehydration unless the patient cannot tolerate it (vomiting, psychological reasons). Reasons of support for oral rehydration are:
- Plasma volume changes are the same for IV and oral by about the 15 minute mark of rehydration
- Plasma osmolality is the same throughout rehydration for IV & oral
- Skin blood flow is the same in oral and IV
- SV, cardiac output, HR are the same in oral & IV
- Skin temperature and rectal temperature are similar in oral as compared to IV
- Similar fluid regulatory hormone responses
- Thirst, Thermal and RPE perceptions are lower for oral as compared to IV

Another aspect of treating a dehydrated individual is the amount of fluid the lay rescuer should provide. Research suggests that the amount should exceed how much the individual lost since urine losses, respiratory losses, and possible sweating will allow additional fluid losses even after rehydration has begun (Shirreffs 1996, Mitchell 2000, Wong 2000, Evans 2009, Merson2008, Shirreffs 2007). Research revealed that hypohydrated individuals did not restore their hydration status when fluid consumed only matched their fluid loss (no matter the electrolyte content of the beverage). However, when 150% of their fluid losses were consumed with a high NaCl content, their hydration status returned to euhydration. The lay rescuer will not be able to determine how much their patient has lost, nor be able to calculate what 150% of their losses would be, however the lay rescuer can be taught to encourage the patient to consume a good amount of fluids by having the patient drink more than just “sipping” while avoiding a “sloshy” feeling. Once the patient has an urge to urinate, it can be assumed that they have reached a good point in the rehydration process.

Acknowledgements:

*Solid research design. Results suggest when treating with a NaCl solution, that there is no benefit of choosing intravenous fluids over oral rehydration.*


*Research design is solid. Dehydration level and subject number slightly low. Results suggest carbohydrate itself doesn't help enhance rehydration. However each of CEB did successfully rehydrate each subject.*


*Research design is solid. Dehydration and subject numbers slightly low. Results suggest that a CEB rehydrates successfully and possibly better than low osmo solutions.*


*Good research design. Results suggest that both water and CEB rehydrate a person successfully as compared to diet cola.*


*Research design is solid. Results suggest that CEB increased PV more than water indicating CEB a better rehydration beverage.*


*Solid research design. Results support that when treating with a NaCl solution there is no difference between intravenous or oral rehydration methods.*


*Solid research design. Results support that when treating with a NaCl solution, there is no difference between intravenous and oral rehydration methods.*

*Solid research design. Results support when using a NaCl solution, there is not a difference between intravenous and oral rehydration methods.*


*Good research design. Results suggest that the oral rehydration is better than IV at decreasing sensations of thirst.*


*A well designed and controlled study. Results suggest that a NaCl beverage, especially higher NaCl content beverages, increases rehydration efforts.*


*Good research design, small amount of subjects. Results suggest all formulations studied of CEB successfully rehydrated subjects.*


*Research design is solid. Results suggest that NaCl beverages successfully rehydrate individuals, especially higher NaCl levels.*


*Very good research design. All NaCl beverages rehydrated subjects successfully, especially those given in significant volumes.*

Research design is solid. Results suggest NaCl beverage rehydrated better than water in terms of plasma volume restoration.


Well designed and controlled study. Results suggest that the CEB rehydrated successfully.


Solid research design. Results suggest that when treating with a NaCl solution, use of oral rehydration may be of benefit to decrease perceptual sensations in the dehydration victim.


Fair research design. Results suggest that the CEB was better compared to water in successful rehydration.


Research design and data collection methods are solid. Results support treating dehydration and sodium sweat losses with NaCl solutions.


Good research design. Results suggest increased volumes of NaCl beverages have successful rehydration.


Good research design. Results suggest high volumes of CEB or just a Carbo beverage successfully rehydrate an individual but that the CEB may be better.