Calling from the UK?
Please dial: **0800 389 7473**
Enter participant pass code: **577 361 72 #**

Calling from outside the UK?
Please check the email sent with your log in details to access our global dial in codes and enter: **577 361 72 #**

Don’t see your country on the global list?
Please dial: **+44 1296 480 180**.
Enter the participant pass code: **577 361 72 #**

Please check with your provider to confirm call charges.

***Press *0 to speak to an operator if you are having any technical difficulties***
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If you want to get involved in the conversation, please click on the Chat icon circled in red.

Select **all participants** from the drop down menu, type your message then click send!
Where are you joining us from?

Please click on the pen icon, circled in red above....
Where are you joining us from?

Please click on the arrow icon, circled in red above....
CLICK ON YOUR LOCATION....
QI Connect: our reach

January 2018

674 organisations

@HISQIConnect
Competition time...
Congratulations!

@HISQICOnnect
FOR THE FIRST TIME ....
All territorial NHS Boards across Scotland are now linking in!
UNIVERSITIES
SPECIAL SHOUT OUT TO...

Glasgow University Aviation & Space Medicine Society
LEARNING TOGETHER..... AGAIN ... AND AGAIN...

View recordings of previous QI Connect sessions
You can find information on our previous speakers and view recordings of sessions at the links below.

### 2014

<table>
<thead>
<tr>
<th>Presenter</th>
<th>Session name</th>
<th>Date</th>
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<tbody>
<tr>
<td>Mike Buist</td>
<td>Why is it that doctors don’t get the quality and safety agenda?: A look at the issues</td>
<td>29 January 2014</td>
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### 2015

<table>
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<tr>
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<tr>
<td>Professor Paul Batalden</td>
<td>Improving the value of the contribution that social and healthcare services make to health</td>
<td>21 October 2015</td>
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### 2016

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### 2017

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<tbody>
<tr>
<td>Chris Ham</td>
<td>Reforming the NHS from within</td>
<td>26 January 2017</td>
</tr>
</tbody>
</table>

http://www.healthcareimprovementscotland.org/our_work/clinical_engagement/qi_connect.asp

@HISQIConnect
The QI Connect series now features as an approved resource within ISQua’s Fellowship Programme
NEW PARTNERSHIP...

Q. health.org.uk or @theQcommunity
QI Connect

**Session Chair:**
Dr Brian Robson
Medical Director

**Series Manager:**
Jennifer Graham
Programme Manager

**Registration:**
Michelle De Felice

**Admin/Certification:**
Carmen Forrest

**Project Officer**
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Dr Catherine Calderwood
Chief Medical Officer
The Scottish Government

@CathCalderwood1

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REMEMBER TO TWEET AS YOU LEARN!

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Dr JD Polk
Chief Health & Medical Officer
NASA
Disaster, Crisis Management, Collaboration and Innovation in a Chilean Mine

J.D. Polk, DO, MS, MMM, CPE, FACOEP, FAsMA
Chief Health and Medical Officer
NASA HQ
Overview

• You are the medical consultant....

• 33 men are trapped in a mine 2,400 feet below solid rock.

• Ages range from 19 to 62

• Known medical conditions in some of the miners are Type 2 diabetes, Silicosis, Hypertension, Coronary Disease, COPD.
2,200 Feet Underground

The 33 miners trapped since an Aug. 5 collapse are living in a small subterranean world. They have access to a workshop with basic tools and a small shelter.

Sources: La Tercera newspaper; WSJ staff reports
Note: Illustrations are based on the accounts of interviews, and may not be exact.
Graphic by Alberto Cervantes/The Wall Street Journal
Benchmarking
Leadership

FLAT, EMPOWERED Leadership chain
Daily Briefings
Crisis Management Team
Recommendations by Phase
What are the initial concerns?

• 600,000 tons of rock collapsed into the mine.

• What two things kill the majority of victims in mine accidents?

• Trauma

• Asphyxiation
Phase 1 - Initial Incident

- Trauma
- Blast pressure
  - Air Filled spaces
- Asphyxia
- Explosion/ignition
- Lethal gases
- Air Sampling performed
- Fresh air pumped in

Figure 3-II. Variations of Overpressure and Dynamic Pressure with Time
Masters of their Own Fate

• 17 days before being found
• Dug wells
• Divided up the rations
Survival

• The miners had one teaspoon tuna, one quarter of a peach, and a teaspoon of milk every other day.

• You finally have a paloma that has reached them.

• You are about to send food down. What is your initial concern?

• Refeeding syndrome
• Liver glycogen has been used up.
• Down-regulation of insulin.
• Brain switches to ketones.
Refeeding Syndrome

• What is the main electrolyte disturbance in refeeding syndrome?

• What other electrolytes are effected?

• What vitamin is of concern?

• Phosphorus (hypophosphatemia)

• Potassium and magnesium (hypokalemia and hyomagnesemia)

• Thiamine (B1)
**Phase 2 - Survival Re-feeding Syndrome**

- Impaired carbohydrate utilization
- Increased insulin release with decreased ability to use free fatty acids
- Increased CO2 production
- Profound hypophosphatemia and hypokalemia
- Gradually increase calories
- Keep the RQ (respiratory quotient) as close to 0.85 as possible.
- Supplement with phosphorus, potassium, and magnesium.
- Water soluble vitamins

Harris- Benedict Equation on caloric need based on basal metabolic rate

\[
\text{BMR} = 66.47 + 6.23 \times \text{Wt (lb)} + 12.67 \times \text{Ht (in)} - 6.76 \times \text{age (yrs)}, \text{Men}
\]
\[
\text{BMR} = 655.1 + 4.34 \times \text{Wt (lb)} + 4.69 \times \text{Ht (in)} - 4.68 \times \text{age (yrs)}, \text{Women}
\]

Protein requirements in catabolic states
1.4gm/Kg/day
Phase 2- Survival
Re-feeding Syndrome

Ensure plus and Supportan:
thiamine, phosphate, potassium,
and protein

and “going low and slow” (10-20 kcal/kg initially) allowed the liver stores to regenerate without causing intracellular shifts. This prevented life-threatening complications from the re-feeding.

• Hypophosphatemia
• Hypokalemia
• Hypomagnesium
• Cardiac dysrhythmias
• Cardiac failure
• Cardiac arrest
<table>
<thead>
<tr>
<th>Product</th>
<th>Energy (kcal/8 oz)</th>
<th>Protein (g/8 oz)</th>
<th>Potassium (mg/8 oz)</th>
<th>Phosphorus (mg/8 oz)</th>
<th>Magnesium (mg/8 oz)</th>
<th>Thiamin (mg/8 oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure</td>
<td>249</td>
<td>9</td>
<td>370</td>
<td>300</td>
<td>100</td>
<td>0.374</td>
</tr>
<tr>
<td>Ensure Plus</td>
<td>352</td>
<td>13</td>
<td>440</td>
<td>200</td>
<td>100</td>
<td>0.375</td>
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<tr>
<td>Ensure Plus High Nitrogen</td>
<td>358</td>
<td>14.8</td>
<td>430</td>
<td>250</td>
<td>100</td>
<td>0.750</td>
</tr>
<tr>
<td>Traumacal, Rtu</td>
<td>355</td>
<td>19.5</td>
<td>330</td>
<td>178</td>
<td>47.5</td>
<td>0.452</td>
</tr>
<tr>
<td>Supportan Drink</td>
<td>356</td>
<td>23.7</td>
<td>303</td>
<td>284</td>
<td>61.6</td>
<td>0.711</td>
</tr>
</tbody>
</table>

1000 ml of product provides:

<table>
<thead>
<tr>
<th>Product</th>
<th>Energy (kcal)</th>
<th>Protein (g)</th>
<th>Potassium (mg)</th>
<th>Phosphorus (mg)</th>
<th>Magnesium (mg)</th>
<th>Thiamin (mg)</th>
</tr>
</thead>
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<tr>
<td>Ensure</td>
<td>1049</td>
<td>38</td>
<td>1559</td>
<td>1264</td>
<td>421</td>
<td>1.6</td>
</tr>
<tr>
<td>Ensure Plus</td>
<td>1483</td>
<td>55</td>
<td>1854</td>
<td>843</td>
<td>421</td>
<td>1.6</td>
</tr>
<tr>
<td>Ensure Plus High Nitrogen</td>
<td>1509</td>
<td>62</td>
<td>1812</td>
<td>1054</td>
<td>421</td>
<td>3.2</td>
</tr>
<tr>
<td>Traumacal, Rtu</td>
<td>1496</td>
<td>82</td>
<td>1391</td>
<td>750</td>
<td>200</td>
<td>1.9</td>
</tr>
<tr>
<td>Supportan Drink</td>
<td>1500</td>
<td>100</td>
<td>1277</td>
<td>1197</td>
<td>260</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Courtesy Scott Smith, PhD and team
Why would the space program be experts in this area?
1 gram of glucose + 0.74L of Oxygen yields 0.74 L of CO2 + 3.75 kcal

Courtesy of Dr. Doug Hamilton and Team
Who else gets refeeding syndrome?

• Neurosurgical patients
• Greater than 5-7 days of malnourishment
• TPN without adequate phosphate.
Starvation and Dehydration

• The mine is 90 degrees and 90 percent humidity
• The miners were sleeping on hot rocks, vehicles, and just about anywhere
• What could be the consequences?
• What test would you use?

• Urine dipstick test was one of first sent down.
• 50% of the miners were positive for myoglobin.
• Rhabdomyolysis and acute tubular necrosis
• Those miners targeted for consumption of 5 liters of water.
Innovation
Competition
Brainstorming Meetings
Phase 3- Sustain
Contingency Re-supply and Stocking

• Contingency Supply
  • Send medical, water, and food supplies sufficient for enough time to re-establish supply chains, in the event of a contingency cave-in or the miners are again cut off from the surface.
Treatment of Chronic Conditions

• The patient with Type 2 diabetes was on metformin prior to the accident.
• Should you begin sending that down?
• What is the physiologic concern with metformin under these circumstances?
• Consider him diet controlled until his calorie count is over 1800 calories and he is no longer spilling ketones.
• Lactic acidosis is the concern.
**Skin**

- Linoleic Acid deficiency-
- Eczema-like rash with neutropenia and thrombocytopenia.
- Unresponsive to steroids or anti-fungals,
- This is easily treated with linoleic acid capsules and supplementation or safflower oil 15cc/day.
Latent Virus Activation

- Herpes Virus family
  - EBV
Immunization

• Vaccination for tetanus (in the form of diphtheria/tetanus toxoid), pneumococcal, and meningococcal strains
• Influenza
• Debate
Phase 3 - Sustain

Common Medical Maladies Seen in Long Duration

• Vitamin D deficiency
• Epstein Barr/Herpes Latent Virus Reactivation
• Constipation
• Respiratory Infections
• Skin Infections/Irritations
• Dental caries and periodontal disease
Alcohol and Tobacco

• Medical versus psych recommendations
• Concerns for nutritional status and unknown Thiamine status
• Assumption of intake upon rescue

• Lung disease versus second hand smoke
• Potential for revolt due to need for control
• Choosing the battles
Psychological Support

• Circadian and sleep-wake cycles
  • Regular cycles of light/dark, exercise and eating in community area (eating, social, etc)
    • Regular time each day for each miner for these things. Preserve an individual’s 24h cycle.
  • Since miners work in 3 shifts, organized 3 distinct lighting areas in mine:
    • Sleeping area
    • Community social area
    • Mining work areas
Phase 4- Rescue
Decompression Risk

- Since the miners are saturated at 3.3 FSW and the most conservative limit for safe direct ascent is 17 FSW, it is unlikely that DCS is a problem.

Tan et al. 2008, Courtesy of Johnny Conkin
The Rescue

• The miners are well nourished, and you have been successful in treating their chronic medical conditions.

• It is time to contemplate the rescue.

• They will have to be upright for the duration of the rescue. What physiologic complications could occur?

• Orthostatic hypotension
• Hypoxia
• Hypercarbia
• Anxiety reaction
How would you combat the physiologic consequences?

- Compression garment
- Salt tablets
- Fluid load
- Sunglasses for UV protection
# Fluid Loading Protocol

<table>
<thead>
<tr>
<th>Miners Mass</th>
<th>Number of 500mg salt tablets at 12 hours prior to ascent</th>
<th>Amount of electrolyte solution at 12 hours prior</th>
<th>Number of 500mg salt tablets at 4 hours prior to ascent</th>
<th>Amount of electrolyte solution at 4 hours prior to ascent</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 kilos</td>
<td>4</td>
<td>38 ounces (1121 ml)</td>
<td>4</td>
<td>38 ounces (1121 ml)</td>
</tr>
<tr>
<td>80 kilos</td>
<td>5</td>
<td>40 ounces (1180 ml)</td>
<td>5</td>
<td>40 ounces (1180 ml)</td>
</tr>
<tr>
<td>85 kilos</td>
<td>5</td>
<td>40 ounces (1180 ml)</td>
<td>5</td>
<td>40 ounces (1180 ml)</td>
</tr>
<tr>
<td>90 kilos</td>
<td>6</td>
<td>44 ounces (1298 ml)</td>
<td>6</td>
<td>44 ounces (1298 ml)</td>
</tr>
<tr>
<td>100 kilos</td>
<td>6</td>
<td>44 ounces (1298 ml)</td>
<td>6</td>
<td>44 ounces (1298 ml)</td>
</tr>
</tbody>
</table>
## The “NASA Diet”

<table>
<thead>
<tr>
<th>Product</th>
<th>Serving</th>
<th>Calories</th>
<th>Carbohydrates (g)</th>
<th>Sodium (mg)</th>
<th>Potassium (mg)</th>
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<tbody>
<tr>
<td>Gatorade G Series 01 Prime</td>
<td>118ml</td>
<td>100</td>
<td>25</td>
<td>110</td>
<td>35</td>
</tr>
<tr>
<td>Gatorade G Series 02 Perform</td>
<td>240ml</td>
<td>50</td>
<td>14</td>
<td>110</td>
<td>30</td>
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<tr>
<td>Gatorade G Series 03 Recover</td>
<td>240ml</td>
<td>60</td>
<td>7</td>
<td>120</td>
<td>45</td>
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<td>Gatorade G Series 01 Pro Prime</td>
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<td>330</td>
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<td>220</td>
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<td>50</td>
<td>14</td>
<td>200</td>
<td>90</td>
</tr>
<tr>
<td>Gatorade G Series 03 Recover</td>
<td>240ml</td>
<td>200</td>
<td>33</td>
<td>190</td>
<td>270</td>
</tr>
</tbody>
</table>
What requirements would you write for the escape pod?
**Rescue capsule**

The 33 workers trapped inside a Chilean mine will be hoisted up one by one:

- Steel cage weighing around 250 kg
- Equipped with oxygen supply
- Built-in audio and video communication system
- Protective gloves, helmet, safety harness inside

**Ascent time**
Between 30 minutes and two hours

**Evacuation system**
If the capsule becomes stuck midway, the miner will be able to exit via an escape hatch and lower himself down using the harness.

- **Door**
  - 3 mm thick, made out of polycarbonate

55 to 60 cm

2 to 2.5 m
Sloping Terrain allows “Ground Effect” for take-off in changing temperatures and weights.
Six Sigma

Why did each miner get placed on a cot and taken to the triage tent when they looked so good coming out?
Phase 5 - Convalescence, Recovery, Reintegration

- The miners are being followed for a period of months for respiratory, skin, and viral syndromes.
- Post Traumatic Stress
- Depression
- Why?
Conclusions

- Innovation, leadership, and mindset of the Chilean government, medical and mining personnel were paramount to the success.
- Lessons from Spaceflight were directly applicable to the ground.
- Spaceflight has a tangible value that is difficult to quantify.
Questions?

Slide courtesy of USAF
Dr Catherine Calderwood
Chief Medical Officer
The Scottish Government

@CathCalderwood1
QI CONNECT 2018: INNOVATION & INTEGRATION

Dr JD Polk
Chief Health & Medical Officer
NASA
25 January

Dr Nirav Shah
Former Senior Vice President & Chief Officer for Clinical Operations
Kaiser Permanente
22 February

Professor Al Mulley
Managing Director, Global Health Care Delivery Science
Professor of Medicine, Geisel School of Medicine
The Dartmouth Institute
29 March

Atul Gawande
Surgeon, Writer & Public Health Researcher
26 April

Toby Cosgrove
Former President & Chief Executive
The Cleveland Clinic
31 May

Danielle Martin
Physician, health care administrator & an associate professor
University of Toronto
21 June

Roy Lilley
Health policy analyst, writer, broadcaster and commentator
27 September

Brene Brown
Scholar, author, and research professor
University of Houston Graduate College of Social Work
Date TBC

Fiona Godlee
Editor in Chief
BMJ
31 October

ePatient Dave
Cancer survivor and expert in the meaningful use of health IT
29 November