Human Factors Assessment and Redesign of the ISS Respiratory Support Pack (RSP) Cue Card

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The Respiratory Support Pack (RSP) is a medical pack onboard the International Space Station (ISS) that contains much of the necessary equipment for providing aid to a conscious or unconscious crewmember in respiratory distress. Inside the RSP lid pocket is a 5.5 by 11 inch paper procedural cue card, which is used by a Crew Medical Officer (CMO) to set up the equipment and deliver oxygen to a crewmember. In training, crewmembers expressed concerns about the readability and usability of the cue card; consequently, updating the cue card was prioritized as an activity to be completed. The Usability Testing and Analysis Facility at the Johnson Space Center (JSC) evaluated the original layout of the cue card, and proposed several new cue card designs based on human factors principles.

The approach taken for the assessment was an iterative process. First, in order to completely understand the issues with the RSP cue card, crewmember post training comments regarding the RSP cue card were taken into consideration. Over the course of the iterative process, the procedural information was reorganized into a linear flow after the removal of irrelevant (non-emergency) content. Pictures, color coding, and borders were added to highlight key components in the RSP to aid in quickly identifying those components. There were minimal changes to the actual text content.

Three studies were conducted using non-medically trained JSC personnel (total of 34 participants). Non-medically trained personnel participated in order to approximate a scenario of limited CMO exposure to the RSP equipment and training (which can occur six months prior to the mission). In each study, participants were asked to perform two respiratory distress scenarios using one of the cue card designs to simulate resuscitation (using a mannequin along with the hardware).

Procedure completion time, errors, and subjective ratings were recorded. The last iteration of the cue card featured a schematic of the RSP, colors, borders, and simplification of the flow of information. The time to complete the RSP procedure was reduced by approximately three minutes with the new design. In an emergency situation, three minutes significantly increases the probability of saving a life. In addition, participants showed the highest preference for this design.

The results of the studies and the new design were presented to a focus group of astronauts, flight surgeons, medical trainers, and procedures personnel. The final cue card was presented to a medical control board and approved for flight. The revised RSP cue card is currently onboard ISS.
Cue card design guidelines developed as a result of this project include:

- Provide a definite “start” and “stop” point
- Create a linear flow of information
- Add numbers to steps
- Add schematic(s) or picture(s) to cue card, but avoid too many pictures/too much detail
- Use color where feasible for identification, but do not overuse color (e.g. for decoration)
- Highlight important words with the use of bold, underlined, or bordered text
Picture Captions

OriginalModified.jpg
*Original RSP Cue Card Design*

RecommendedCueCardwithColors.jpg
*Redesigned RSP Cue Card (3 minute savings)*
### UNCONSCIOUS PATIENT

1. Deploy RSP, ALSP and Defibrillator
2. Pull red metal cap off Regulator Supply Hose and connect to Oxygen port (\*If CHECS unavailable, use PBA port\*)
3. Autovent \textbf{BPM knob} \rightarrow white dot (●)
4. Regulator \textbf{WHITE indicator line} \rightarrow 12
5. From ALSP, retrieve blue Ambu Bag and attach Ambu Bag Tubing to RSP \textbf{Regulator hosebarb}
6. Place Ambu Bag on Patient and give 1 breath every 5 sec while preparing ILMA (in IK/A)
7. From IK/A, insert ILMA, using ILMA, cue card
8. Regulator \textbf{WHITE indicator line} \rightarrow 0
9. Autovent \textbf{BPM knob} \rightarrow 12
10. Autovent \textbf{Tidal Volume} \rightarrow 800
11. Verify movement of green indicator on top and feel for Oxygen flow from \textbf{Patient Valve}
12. \textbf{Patient Valve} \rightarrow ILMA
13. Contact Flight Surgeon
14. Monitor patient

### CONSCIOUS PATIENT

1.Deploy RSP, ALSP and Defibrillator
2. Pull red metal cap off Regulator Supply Hose and connect to Oxygen port (\*If CHECS unavailable, use PBA port\*)
3. Autovent \textbf{BPM knob} \rightarrow white dot (●)
4. Regulator \textbf{WHITE indicator line} \rightarrow 12
5. Remove Low Flow Non-Rebreather Mask from RSP lid pocket and attach Mask Inlet Tubing to \textbf{Regulator}
6. Put mask on patient
7. Contact Flight Surgeon
8. Monitor patient
RESPIRATORY SUPPORT PACK: RSP CUE CARD #1

RESPIRATORY SUPPORT PACK (RSP) SETUP ALGORITHM

PCS
Unlock: ECLSS O2 Lo P SplyVv
AL O2 Lo P SupplyVv
cmd Open
Verify Actual Position OPEN.

RSP SETUP
1. Deploy RSP.
2. Remove metal ductcap from Regulator supply hose and connect to CHeCS O2 supply hose.
   (*If CHeCS O2 supply unavailable, attach PBAs or shuttle O2 source.)
3. Decide whether to use Low Flow Mask, Ambu Bag, or Intubate. (If intubating, attach patient valve to ILMA.)
4. Set RSP, BPM = 12, TV = 500.
5. Determine if additional treatment is required.

CONSCIOUS
02 to Low Flow Mask
- BPM knob = dot
- Set Regulator flow rate = 12 L/min (CAUTION: use WHITE Indicator line).
- Output by feeling for 02 flow from Regulator hose/branch.
- Remove Low Flow Mask from RSP lid pocket and attach O2 tubing to Regulator hose/branch.
- If Low Flow Mask will be used for > 16 minutes, disconnect Autovent supply hose from Regulator at Quick Disconnect (QD).

UNCONSCIOUS
02 to Ambu Bag
- Turn Autovent BPM knob = dot
- Set Regulator flow rate to 12 L/min (CAUTION: use WHITE Indicator line).
- Output by feeling for 02 flow from Regulator hose/branch with hand.
- Remove Ambu Bag from ALSF and attach Ambu Bag O2 supply hose to Regulator hose/branch.
- Give one breath every 5 seconds with Ambu Bag and Mask (or remove mask and attach Ambu Bag to ILMA).
- If Ambu Bag will be used for > 16 minutes, disconnect Autovent supply hose from Regulator at Quick Disconnect (QD).

INTUBATED
02 to ILMA
- For use only in intubated patient.
- Set Regulator flow rate = 0 L/min (CAUTION: use WHITE Indicator line).
- Set Autovent BPM = 12 initially.
- Set Autovent Tidal Volume = 800 ml
- "For 02 flow by observing movement in green indicator on top of Patient Valve and by feeling for 02 flow.
- Attach Patient Valve to ILMA.
- Secure O2 line as needed.

Patient Transported to Earth
- Remove Patient Extension Hose from RSP lid pocket and remove one Heat and Moisture Exchanger (HME) from RSP.
- Attach top (small end) of HME to L-shaped end of Extension Hose.
- Quickly disconnect Patient Valve from ET Tube, connect HME to ET Tube, and connect Extension Hose to Patient Valve.
- Retrieve Portable Breathing Apparatus (PBA).
- Obtain ISS Manned Systems Extension O2 line from Node or Airlock.
- Connect Extension O2 line to space shuttle O2 source: Panel M066MMD/0 M2M.
- Switch O2 supply from ISS CHeCS Rack to PBA.
- Move patient to shuttle.
- Switch O2 supply from Portable O2 bottle to shuttle O2 source via extension line.
- Secure patient in shuttle for return to Earth.
- Secure Autovent, Regulator, Patient Valve, and all flex lines near patient with Velcro straps in RSP lid.

Will patient be transported back to Earth via shuttle?

YES

Patient NOT Transferred to Earth
- If patient is to remain on Autovent > 15 min, insert HME between Patient Valve and ET Tube.
- Complete patient treatment per ISS Medical C/L or Surgeon instructions.
- Use an Alcohol Pad to clean used equipment.
- Restow RSP.

ISS MED-1ab/ALL/A