Update on Rebreather Forum 3

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Rebreather Forum 3 (RF3) was held in May 2012 to review the state of rebreather diving (equipment, operations, accidents and accident prevention) and consider the best path forward to further enhance safety and readiness (*www.rf30.org*). The conference was organized by the American Academy of Underwater Science (AAUS), Divers Alert Network (DAN) and the Professional Association of Diving Instructors (PADI).

Approximately 400 delegates participated in RF3 from across the globe, including many leading experts. Represented communities include commercial, media, military, recreational, scientific and technical.

The three day meeting resulted in the following 16 consensus statements:

CHECKLISTS

The forum acknowledged the overwhelming evidence demonstrating the efficacy of checklists in preventing errors in parallel fields that share similar technical complexity.

1) The Forum recommends that rebreather manufacturers produce carefully designed checklists, which may be written and / or electronic, for use in the pre-dive preparation (unit assembly and immediate pre-dive) and post-dive management of their rebreathers.
   - Written checklists should be provided in a weatherproof or waterproof form
   - The current version of these checklists annotated with the most recent revision date should be published on the manufacturer's website

2) The Forum recommends that training agencies and their instructors embrace the crucial leadership role in fostering a safety culture in which the use of checklists by rebreather divers becomes second nature.

TRAINING AND OPERATIONS

1) The forum applauds and endorses the release of pooled data describing numbers of rebreather certifications by training agencies, and encourages other agencies to join ANDI, IANTD, and TDI in this initiative.

2) The Forum endorses the concept of making minimum rebreather training standards available in the public arena.

3) The Forum endorses the concept of a currency requirement for rebreather instructors. We recommend that training agencies give consideration to currency standards in respect of diving activity, class numbers, and unit specificity for their instructors.

4) The Forum recognizes and endorses the industry and training agency initiative to characterize 'recreational' and 'technical' streams of sport rebreather diver training. These groups will have different operational, training and equipment needs.

ACCIDENT INVESTIGATION

1) The Forum recommends that training agencies provide rebreather divers with a simple list of instructions that will mitigate common errors in evidence preservation after a serious incident or rebreather fatality.
   - These instructions will be developed under the auspices of the Undersea and Hyperbaric Medical Society Diving Committee in consultation with the relevant RF3 presenters.

2) The Forum endorses the concept of a widely notified centralized 'on-call' consultation service to help investigators in avoiding errors or omissions in the early stages of a rebreather accident investigation, and to facilitate referral to expert investigative services.

3) The Forum recommends that in investigating a rebreather fatality the principal accident investigator invite the manufacturer of the incident rebreather (or other relevant equipment) to assist with its evaluation (including the crucial task of data download) as early as is practicable.

4) The Forum endorses the DAN worldwide initiative to provide a means of on-line incident reporting with subsequent analysis and publication of incident root causes.

DESIGN AND TESTING

1) The Forum recommends that all rebreathers incorporate data logging systems which record functional parameters relevant to the particular unit and dive data, and which allow download of these data. Diagnostic reconstruction of dives with as many relevant parameters as possible is the goal of this initiative.
   - Footnote: An ideal goal would be to incorporate redundancy in data logging systems, and as much as practical, to standardize the data to be collected.

2) The Forum endorses the need for third party pre-market testing to establish that rebreathers are fit for purpose. Results of a uniform suite of practically important unmanned testing parameters such as

canister duration, and work of breathing (qualified by clear statements of experimental parameters) should be reported publicly. Ideally, this testing should be to an internationally recognized standard.

3) The Forum acknowledges recent survey data indicating a poor understanding of rebreather operational limits in relation to depth and carbon dioxide scrubber duration among trained users, and therefore recommends:

   a) that training organizations emphasize these parameters in training courses.

   b) that manufacturers display these parameters in places of prominence in device documentation and on websites.

4) The Forum strongly endorses industry initiatives to improve oxygen measurement technologies, and advocates consideration of potentially beneficial emerging strategies such as dynamic validation of cell readings and alternatives to galvanic fuel cells.

5) The Forum identifies as a research question the issue of whether a mouthpiece retaining strap would provide protection of the airway in an unconscious rebreather diver.

6) The Forum identifies as a research question the efficacy of a full face masks for use with sport rebreathers.

PRODUCT FOR THE COMMUNITY

The consensus statements were released immediately following the meeting. Published proceedings will be available Summer 2013 that capture the presentations and discussion. In addition, a number of the presentations were recorded and are available for viewing through the RF3 website (*www.rf30.org*: go to the 'presentation page' and click on 'video link'). Videos are being added periodically to the site. These lectures are educational tools available to all.

Dr. Nicholas Bird's Q. & A. Corner

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Q. & A.

Test your knowledge in dive medicine.

1. Technical diving is commonly characterized as:

- **a.** Diving beyond the depth and time limits of no-decompression recreational diving.
- **b.** Involves the use of mixed gas, deep depths and often physical ceilings like caves, shipwrecks and ice.
- **c.** Often associated with decompression obligations or a physiological ceiling.
- **d.** May involve switching gas supplies (use of multiple tanks) or use of rebreathers.
- **e.** All of the above.

2. Which of the following is true?

- **a.** The percentage of cardiac related deaths in divers is estimated at 20-30%.
- **b.** Sudden cardiac death often occurs in people characterized as low risk.
- **c.** One of the goals of further study is to determine factors associated with elevated risks for sudden cardiac death.
- **d.** Physiological factors associated with sudden cardiac death include, reduced parasympathetic tone and LVH.
- **e.** a and b.
- **f.** All of the above.

3. Medical/physiological considerations regarding age and safe diving include:

- **a.** Physical fitness.
- **b.** Comorbidities.
- **c.** Mobility and strength.
- **d.** Type of equipment used.
- **e.** Certification agency.
- **f.** a, b, and c.
- **g.** All of the above.

4. The NFPA sets standards regarding the frequency of air quality tests. According to chapter 14 of NFPA, testing should occur:

a. Every 3 months.
b. Every 6 months.
c. Every 9 months.
d. Annually.
e. After each major repair or modification of the compressors.
f. b and e.
g. c and e.

... answers on page 20.

Quiz Answers 1. e, 2. f, 3. f, 4. f

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