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Department of Anaesthesiology  
and Intensive Care Medicine  
University Hospital of Cologne



# Introduction to ESAM Space Medicine Group

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Jochen Hinkelbein



none



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# Soyuz



Soyuz





ISS

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# Members





Braunecker	Stefan	Kings college	London	UK
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Hinkelbein	Jochen	DGLRM	Cologne	Germany
Kerkhoff	Steffen	DGLRM	Cologne	Germany
Kolaparambil				
Varghese	Lydia Johnson	University of Perugia	Rome	Italy
Komorowski	Matthieu	Imperial College London	London	UK
Luton	Dominique	Soframas, ASMA, AF, Univ Paris VII	Paris	France
Panait	Cristian	EASA	Cologne	Germany
Pavy-Le Traon	Anne	Medes – Institut de Médecine et Physiologie Spatiales, Toulouse	Toulouse	France
Saehle	Terje	Civial Aviation authority Norway	Oslo	Norway
Schmitz	Jan	DGLRM	Cologne	Germany
Simons	Ries	ESAM, TNO (Netherlands Organization for Applied Scientific Research)	Soesterberg	Netherlands
Stern	Claudia	DLR	Cologne	Germany
Strollo	Felice	AIMAS	Roma	Italy

# Statutes and goals of the ESAM space medicine group

## ESAM SPACE MEDICINE GROUP – ESMG

### Memorandum of Association

The Objectives are the same of ESAM, in the specific sector of Space Medicine

- To work for the safety and health of people involved in space operations.
- To be a pan-European independent forum for space medicine and to coordinate European space medicine interests in the applicable fora.
- To build space medicine decisions upon knowledge, evidence and open discussions within the organisation.
- To assist in developing and harmonising training in aerospace medicine throughout Europe, for doctors and nurses and for astronauts.
- To encourage information exchange and dialogue between the national aeromedical associations in the specialty of space medicine.
- To exchange scientific results and experiences.
- To develop relations with ESA, ROSKOSMOS, NASA, and other relevant organisations.

# ESAM-SMG is open to everyone – Please join!



# Visibility





# Facebook: @esamspacemedicinergroup

The screenshot shows the Facebook profile page for the 'ESAM - Space Medicine Group'. The page header displays the group's name and the URL [www.facebook.com/esamspacemedicinergroup/](http://www.facebook.com/esamspacemedicinergroup/). The cover photo features the European Union flag's yellow stars forming a circle around a white caduceus symbol, with a white rocket ship trajectory line and the text 'ESAM Space Medicine Group' overlaid. The left sidebar includes links for 'Startseite', 'Beiträge', 'Bewertungen', and 'Promotions verwalten'. A blue 'Hervorheben' button is visible at the bottom of the sidebar. The main content area shows a welcome message: 'Willkommen auf deiner neuen Seite' (Welcome to your new page) and a prompt to share the page with friends. A search bar at the bottom right says 'Nach Freunden zum Einladen suchen' (Search for friends to invite).

# Social media

approx. 1100 followers

Please join!  
@EsamGroup

o2-de LTE 07:04 81 %

Profil bearbeiten

**ESAM Space Medicine Group**  
@EsamGroup

#Space #Medicine Group of the European Society of Aerospace Medicine (#ESAM). 🚀🚀

Chair: @ProfHinkelbein

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Mai 2018 beigetreten

3.245 Folge ich 1.067 Follower

Tweets Tweets & Antworten Medien

Du hast retweetet

Adam Crellin @OxfordSpaceDoc · 1t  
Question: How bad would it be if an #astronaut had a heart attack in #space?  
Me: ...very bad!

Check out why cardiac arrest in space

13 Prof. Dr. Jochen Hinkelbein



AEROSPACE MEDICAL  
ASSOCIATION

AsMA 2019 in Las Vegas

ESAM-SMG session on  
Space Medicine

ABSTRACT  
SUBMISSION NOW  
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The NEW abstract submission site for AsMA's 90th Annual Scientific Meeting is now OPEN. Visit the Submission page for more information. The deadline is November 1, 2018. NO EXCEPTIONS!

[SUBMIT AN ABSTRACT](#)



# Member projects



# Mapping the educational and training opportunities in space medicine in Europe.



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# The Impact of a Haemodynamic Push-Pull Effect on Gz Tolerance During Simulated Sub-Orbital Spaceflight

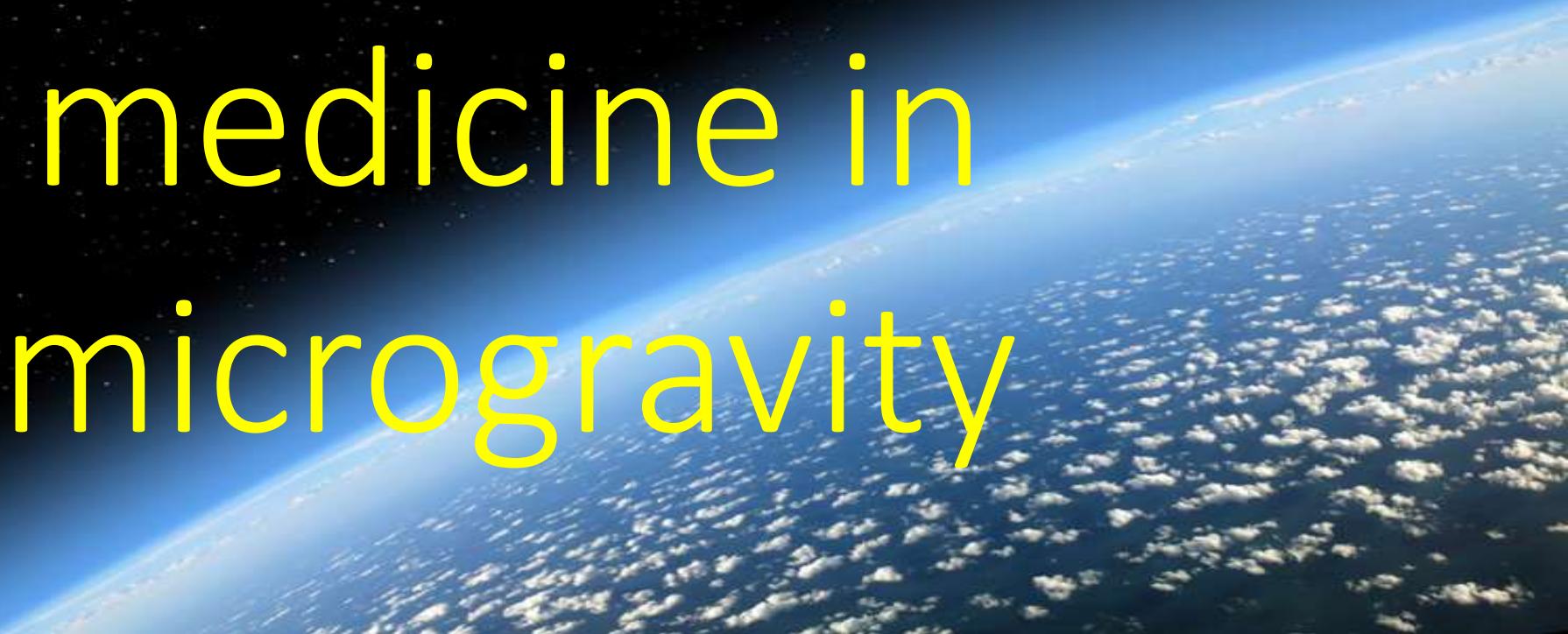
Ground-based simulator (Desdemona) profiles were used to assess the effects of 3-min head down tilt (as hemodynamic “microgravity” condition) followed by an acceleration to +3Gz sustained for 15 s. By comparing this condition to the same condition without head down tilt preceding the acceleration, we aimed to assess the magnitude of effects of the transition of simulated 0G to +3Gz (“push-pull”) on heart rate, cerebral perfusion, and subjective G-tolerance parameters. Cerebral perfusion was assessed using NIRS (Near Infra-Red Spectroscopy).



Cancer & Health Research in Space (CHRIS). A Study on Glioblastoma in Microgravity". Other studies are related to Multiple Sclerosis.



# Emergency medicine in microgravity



# Risk of astronauts for medical emergencies in space flight

- More long-term missions (Mars and Moon) as well as space tourism
- Risk in a group of 6 astronauts:  
**1 significant emergency in  
2.8 years**



REVIEW

Curr Opin Anesthesiol 2016, 29:000–000

DOI:10.1097/AOC.0000000000000390



**Anaesthesia in outer space: the ultimate ambulatory setting?**

Matthieu Komorowski<sup>a,b,c</sup>, Sarah Fleming<sup>d</sup>, and Jochen Hinkelbein<sup>e</sup>

## Leitthema

Notfall Rettungsmed 2015 · 18:268–273  
DOI 10.1007/s10049-014-1979-8  
Published online: 7 June 2015  
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Redaktion  
J. Hinkelbein, Köln  
H. Moecke, Hamburg

M. Komorowski<sup>1</sup> · C. Neuhaus<sup>2, 3</sup> · J. Hinkelbein<sup>2, 4</sup>

<sup>1</sup> Department of Bioengineering, Imperial College London, UK

<sup>2</sup> Working group "Emergency Medicine and Air Rescuer", German Society of Aviation and Space Medicine (DGURM) e. V., Munich, Germany

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## Emergency medicine in space

## Science News

*from research organizations*

# Emergency medicine in space: Normal rules don't apply

Date: June 5, 2017

Source: ESA (European Society of Anaesthesiology)

Summary: Scientists are considering the unusual and challenging problem of how to perform emergency medical procedures during space missions.

Share:      

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PREMIUM MÄNNERPFLEGE

bei Amazon Beauty

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[Home](#) / [Lifestyle](#) / [Science](#) / 'Manned missions to Moon, Mars may face medical emergencies'

## 'Manned missions to Moon, Mars may face medical emergencies'

Astronauts on missions to deep space such as Mars may face severe medical emergencies like heart attacks, say experts who suggest that the crew must prepare to deal with potentially fatal illnesses or injuries.

Anaesthesia  
concerns in  
space flight



# Anesthesia during space flight

npj Microgravity

[www.nature.com/npjmggrav](http://www.nature.com/npjmggrav)

REVIEW ARTICLE

OPEN

## Anaesthesia in austere environments: literature review and considerations for future space exploration missions

Matthieu Komorowski<sup>1,2,3</sup>, Sarah Fleming<sup>4</sup>, Mala Mawkin<sup>1</sup> and Jochen Hinkelbein<sup>5</sup>

EDITORIAL VIEWS

Anesthesiology  
2000; 92:1219–22  
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Lippincott, Williams & Wilkins, Inc.

## *Anesthetic Concerns of Spaceflight*

- Remote / austere environment
- Communication delay up to 20 min
- No medical doctor available
- Anaesthesia may significantly influence mission outcome
- Training and protocols / algorithms are essential



Regional anaesthesia seems to be more optimal

Intubation needs longer time and is more complex

REVIEW ARTICLE

## Regional Anesthesia for the Management of Limb Injuries in Space

GREGORY L. SILVERMAN AND COLIN J. McCARTNEY

Anesthesiology 2006; 105:690–702

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### Airway Management with Endotracheal Tube versus Combitube® during Parabolic Flights

Werner Rabitsch, M.D.,\* Doris Moser, Ph.D.,† Michelle R. Irizunza, R.N., L.P.,‡ Monika Niedermayr, M.D.,§ Wolfgang J. Köstler, M.D., Thomas Staudinger, M.D.,\* Gottfried J. Locker, M.D.,\* Peter Schellongowski, M.D.,|| Beatrix Wulkersdorfer, M.D.,|| James M. Rich, C.R.N.A.,† Brigitte Meyer, M.D.,\*\* Jonathan L. Benumof, M.D.,†† Michael Frass, M.D.\*



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Airway  
management

**REVIEW ARTICLE**

# Airway management in microgravity: A systematic review

Tobias Warnecke<sup>1</sup>  | Felix Tochtermann<sup>2</sup> | Steffen Kerkhoff<sup>3,4,5</sup>Matthieu Komorowski<sup>5,6</sup> | Christopher Neuhaus<sup>4,7</sup> | Jochen Hinkelbein<sup>3,4,5</sup> 

WARNECKE ET AL.

**TABLE 1** Characteristics of the included studies

Authors	Year	Method	Model	Participants	Airway device	Setting
Keller et al <sup>24</sup>	2000	Randomized comparative	Manikin	4	Four different	Submerged
Rabitsch et al <sup>26</sup>	2006	Randomized comparative	Manikin	4	Endotracheal intubation VS Combitube©	Parabolic flight
Groemer et al <sup>37</sup>	2005	Randomized comparative	Manikin	3	Endotracheal intubation	Parabolic flight

Anesthesiology  
2000; 92:1237-41  
© 2000 American Society of Anesthesiologists, Inc.  
Lippincott Williams & Wilkins, Inc.

# *Airway Management during Spaceflight*

## *A Comparison of Four Airway Devices in Simulated Microgravity*

Christian Keller, M.D.,\* Joseph Brimacombe, M.B., Ch.B., F.R.C.A., M.D.,† Marzia Giampalmo, M.D.,‡  
Axel Kleinsasser, M.D.,§ Alex Loeckinger, M.D.,|| Giuseppe Giampalmo, Ph.D.,# Fritz Pühringer, M.D.\*\*

ETI failure: 85%

(in anaesthetists!)

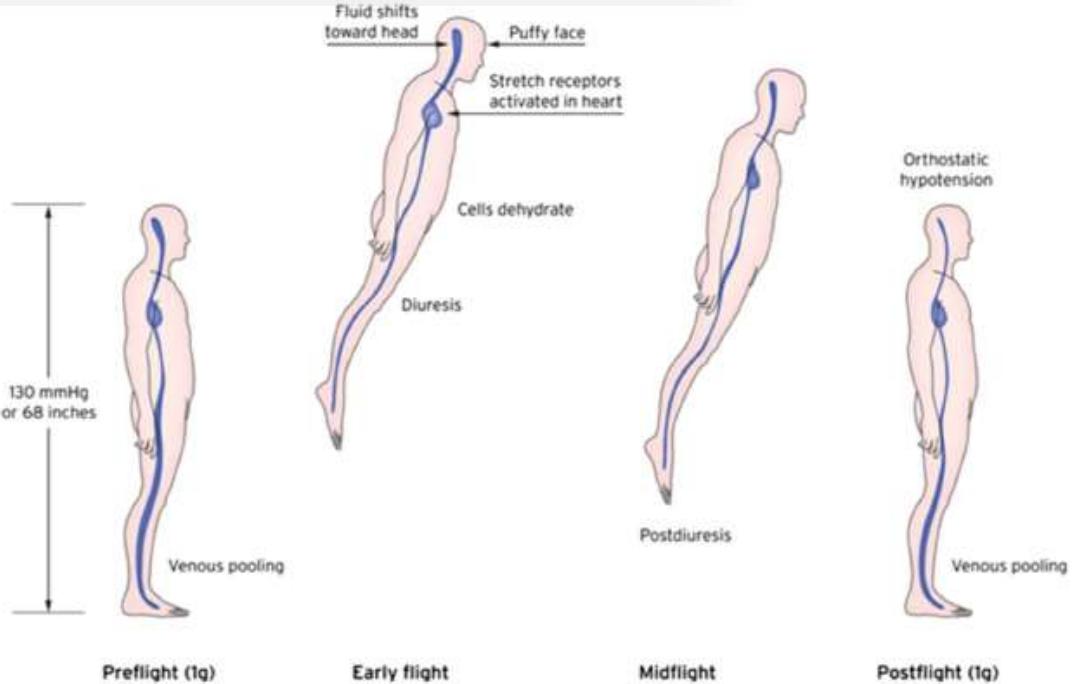


# CPR in microgravity



## REVIEW ARTICLE OPEN

## Anaesthesia in austere environments: literature review and considerations for future space exploration missions

Matthieu Komorowski<sup>1,2,3</sup>, Sarah Fleming<sup>4</sup>, Mala Mawkin<sup>1</sup> and Jochen Hinkelbein<sup>5</sup>

# Example: blood volume

## Effects of Spaceflight on Astronaut Brain Structure

**TO THE EDITOR:** In the study by Roberts et al., astronauts underwent magnetic resonance imaging (MRI) of the brain significantly earlier after long-duration spaceflights than after short missions (4.2 vs. 9.6 days). This factor could confound the interpretation of their data. If changes in brain structure improve after spaceflight, the shorter interval after long-duration flights might explain more prominent findings. This hypothesis is supported by the report by Alperin et al.,<sup>1</sup> which showed that long-duration spaceflight was associated with structural changes in the brain accompanied by substantially increased volumes of cerebrospinal fluid and that these changes were reversible within 1 month, timing that could have contributed to the findings by Roberts et al.

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Cologne, Germany

No potential conflict of interest relevant to this letter was reported.

L. Alperin N, Bagci AM, Lee SH. Spaceflight-induced changes in white matter hyperintensity burden in astronauts. *Neurology*. 2017;90:2187-91.

DOI: 10.1056/NEJMCI180640

## Results:

Hydrocephalus

VIIP syndrome (Vision Impairment and Intracranial Pressure )

Nausea, vomiting, headache

Collapse

Cardiac arrhythmia

Anatomical changes (puffy face etc.)

...



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UVR microgravity  
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Search results Items: 12

Send to: Filters: Manage filters Print related data Category: DARECAT

Originalien

Horst Auer et al.  
DOI 10.1007/s00134-005-0212-z  
© Springer Verlag Berlin Heidelberg 2005

Redaktion  
M. Fischer, Salzburg  
K.-G. Kaud, München  
W. Schmid, Wien  
D. Walther, Magdeburg



Method 1: Everts-Russomano



Method 2: Waist Straddle



Method 4: Standard Straddle



Method 5: Reverse Bear-Hug



Astronaut Bursch performs CPR on a "human chest" dummy on the ISS.

Method 3: Hand-Stand



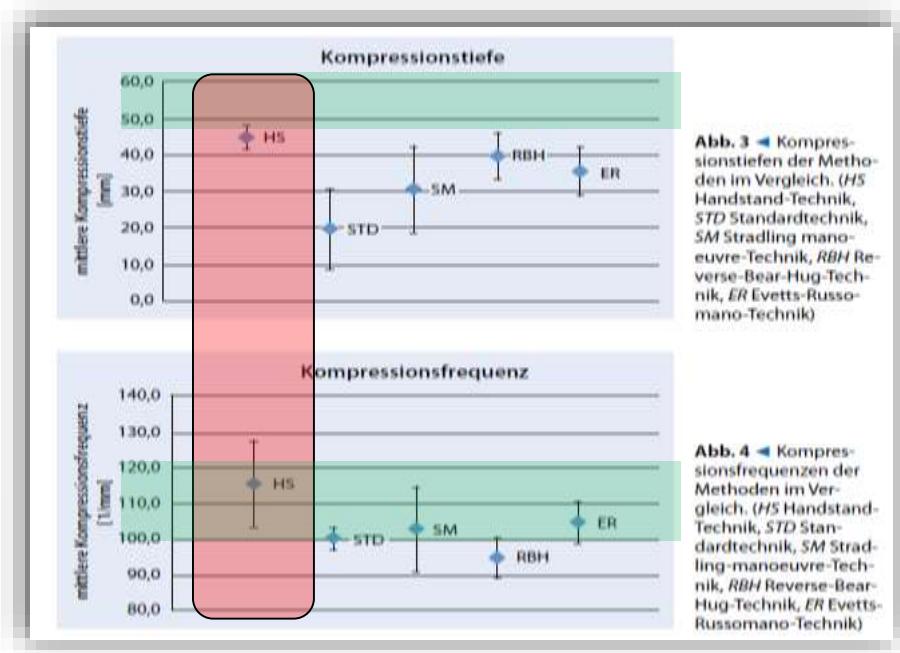
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# The Hand-Stand-Method seems to provide best CPR-quality in microgravity



33 Prof. Dr. Jochen Hinkelbein



**Abb. 3** Kompressionstiefen der Methoden im Vergleich. (HS Handstand-Technik, STD Standardtechnik, SM Stradling manoeuvre-Technik, RBH Reverse-Bear-Hug-Technik, ER Evetts-Russo-mano-Technik)

**Abb. 4** Kompressionsfrequenzen der Methoden im Vergleich. (HS Handstand-Technik, STD Standardtechnik, SM Stradling-manoeuvre-Technik, RBH Reverse-Bear-Hug-Technik, ER Evetts-Russo-mano-Technik)



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# Using mechanical devices in microgravity

**Pushing the Limits of Aerospace Medicine Together**  
**5<sup>th</sup> ECAM** in cooperation with Aerospace Medical Association and  
Norwegian Association of Aviation Medicine

# Mechanical devices

## Cardiopulmonary Resuscitation In Microgravity Using The LUCAS™ 2 Compression Device

John Bousquet<sup>1</sup>, Catherine Nader<sup>1</sup>, Michael Kohler<sup>2</sup>, Kyle Finsen<sup>3</sup>, Katherine Ngai<sup>4</sup>, John S. Potts<sup>5</sup>, Health and Medical Enterprises, San Diego, CA, USA  
1-5THME, 3049 9th Avenue, Makuhari, Chiba, 277-0008, Japan  
3-National Hospital Organization, Miyakojima Medical Center (in Shioya, Miyakojima, Okinawa, Japan)

### INTRODUCTION:

While the basic cardiopulmonary resuscitation procedure (CPR) is commonly practiced on Earth, it is inefficient in a high-g environment without modifications (Figure 1 left). The LUCAS™ 2 CPR device can help aerosol the patient and delivers sustained chest compressions, helping users that avoid fatigue using traditional CPR methods in zero gravity including the need for walls and tissues (Figure 1 right).

### METHODS:

The LUCAS™ 2 CPR device was strapped to a CPR manikin, which was tied to a backboard or leaned a Boeing 727 modified for parabolic flight. A tape measure was attached to the CPR device and its position was recorded prior to the patient's arrival. During the experiment, the patient performed compressions while the manikin's chest, which were recorded via a GoPro camera that was attached to the manikin's elbow, was monitored by a video monitor and a video camera was attached to the manikin's head. The LUCAS™ 2 CPR device can be battery power and non-invasive for ~7 minutes. Chest compression depth were graded by viewing the tape measure (Figure 2) in Adobe Photoshop Pro CS (a color calibration camera) on a 32" full array LCD TV. Statistical analysis was performed using the ANOVA test.

### RESULTS:

Baseline, the depth of compression using a bare manikin, Earth gravity ( $n = 27$ ) averaged 4.02 compressions (error 0%), Moon gravity ( $n = 42$ ) averaged 4.09 compressions ( $\pm 0.09\%$ ), Lunar gravity ( $n = 39$ ) averaged 4.10 compressions ( $\pm 0.07\%$ ), and zero gravity ( $n = 39$ ) averaged 4.03 compressions ( $\pm 0.17\%$ ). An ANOVA test showed no difference among the four groups. A *t*-test showed that Earth gravity and zero gravity were significantly different ( $p < 0.834$ ) and that Earth gravity and Moon gravity were significant ( $p < 0.001$ ). Compression rate did not differ, Earth, Moon, and zero G CPR were 108.8, 107.9, 106.8, and 106.6 compressions per minute respectively.

### DISCUSSION:

The LUCAS™ 2 CPR device provided similar compression depth in 1G and 0G environments (Figure 3). Baseline compression depth reported here are very close to recommended placement. This also suggests ergonomics when Earth and Moon are similar to using CPR after these parabolas and most the patients for Earth vs. zero G CPR. Compression rates were similar on these four environments. An experienced operator should be able to deliver adequate CPR in space using the LUCAS™ 2 CPR device.

### ACKNOWLEDGEMENTS:

Funding from: United the LUCAS™ 2 CPR device for testing. Physician-First did not contribute financially to this study. Financial support from the Japan Ministry of Economy, Trade and Industry (partial financial support: Ishikawa Berika, Kosen University, Waseda University, Makuhari-Honjo, Akita Institute, Peter and Dorothy Scampanier, Kajima Masayuki, Juno Kamei, Atsushi Tsuchihashi, KUREYHI, the American and Norwegian air forces). The authors declare no conflicts of interest for this article.

### REFERENCES:

1. Bousquet J, Nader C, Kohler M, et al. Comparison of different techniques for managing a single in-hospital cardiac arrest: compression quality for space environments. Ann Emerg Med. 2013;61(3):310-316.e1. PMID: 23516579

### ACKNOWLEDGEMENTS:

Thank you to Dr. Alex Sosichuk for technical support. Thank you to Barbara Poffing for the literature review. Thank you to our anonymous one who helped make this project possible.

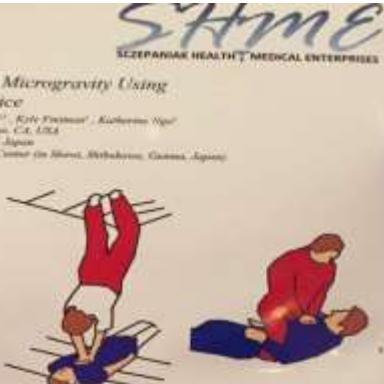


Figure 2 (left) Unpressured (right) Fully compressed CPR

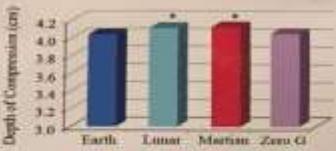
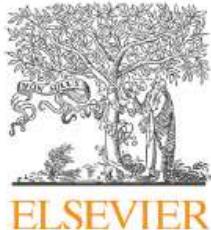


Figure 3-Chart comparing the depth of compression in different gravity environments. \* indicates that Earth and Moon were not different, but were significantly different from Mars and ZG also showed no significant difference in depth when compared



Contents lists available at [ScienceDirect](#)

## Trends in Anaesthesia and Critical Care

journal homepage: [www.elsevier.com/locate/tacc](http://www.elsevier.com/locate/tacc)



### Cardiac arrest during space missions: Specificities and challenges

Jochen Hinkelbein <sup>a,b,\*</sup>, Thais Russomano <sup>c</sup>, Franziska Hinkelbein <sup>a</sup>,  
Matthieu Komorowski <sup>d,e,f</sup>



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A photograph showing several astronauts in white and blue striped spacesuits inside a cramped space station module. They are working on equipment, with one astronaut in the foreground looking towards the camera. The background shows various control panels and equipment. A red text box in the upper right corner contains the text "Critically ill?!"

Critically ill?!

# Questionable results despite young and healthy astronauts

Ethical problems:

Post-ROSC-therapy not possible

Medication shortage can risk whole mission

After ROSC: transport to Earth not possible

Would you even start CPR in this setting?

## 56. Wissenschaftliche Jahrestagung der DGLRM e. V.



**SAVE THE DATE!**  
**Jahrestagung 2018**  
Deutsche Gesellschaft für  
Luft- und Raumfahrtmedizin e. V.

**18.-20. Oktober 2018 in Speyer**



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