



Space
Medicine
Life
Sciences

*Space Medicine & Life Sciences
Project Group*

Annual Report 2020

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SMLS Project Group Overview

The SGAC Space Medicine & Life Sciences (SMLS) Project Group continues to go from strength-to-strength and has achieved many significant goals as outlined in our original strategic and planning document. In 2020, despite the significant impact from the COVID-19 pandemic, our project group had been able to adapt many of our activities to a virtual format and achieved growth of 125% over this past year.

Scope and Objectives

The core vision for the project group is to be an international, intercultural and interdisciplinary platform for young professionals with an interest in space biomedical science. Our project group objectives are:

1. To provide a global interdisciplinary platform to build a community of young professionals in space medicine and life sciences in collaboration with international stakeholders within the space sector.
2. To work towards tangible space applications that address terrestrial healthcare issues, aligned to the United Nations (UN) Sustainable Development Goals (SDGs).
3. To address space medical issues associated with the unique challenges associated with extreme space environments and work towards standardised evidence-based space medical guidelines.

Project Group Achievements 2020

In 2020, the SGAC Space Medicine and Life Sciences (SMLS) project group committee focused on the community building aspect of our mission and objectives. Building on the infrastructures established last year, we trialled a number of different events, projects, and competitions to engage with the members of our community. The aim of which was to encourage active participation and engagement to create an active and vibrant community.

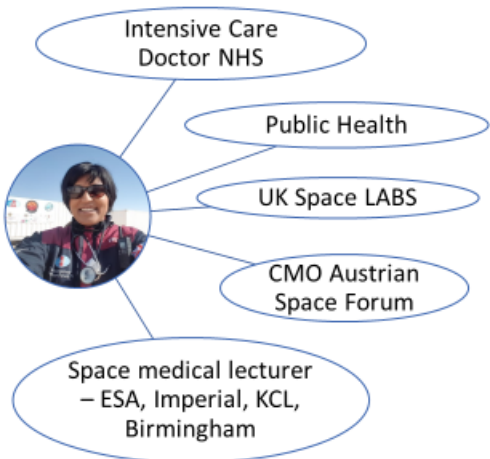
This effort was both hampered and accelerated by the COVID-19 pandemic. While our planned in-person activities were cancelled as a result of the ongoing public health emergencies, the pandemic also highlighted the importance of space technologies on global health and provided an avenue for members to contribute their space-oriented skills to the global effort against the pandemic.

This report outlines our key achievements in capacity building a community of early career researchers, and mentors in the field of space life sciences.

Our Team

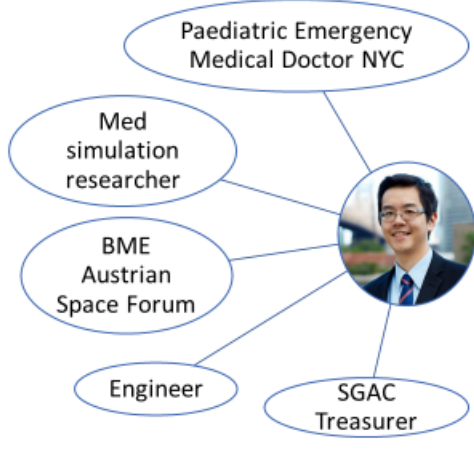
SMLS co-leads + founders Space Medicine and Life Sciences

Dr Rochelle Velho



- UNOOSA Space for Global Health group
- SGAC SMLS initiatives
- NASA ExMC

Assistant Prof. Anthony Yuen



SMLS committee → global, multidisciplinary



Eleanor Frost (UK)
SMLS Vice-lead
UCL MSc Medical Physics and Engineering → medical student



Devjoy Dev (UK/USA)
SMLS Vice-lead
Biomedical engineer MIT/NYC, Analog astronaut MRDS



Mariam Naseem (Pakistan/Canada)
Membership co-Ordinator
Electrical Engineer, SGAC POC Canada, Euroconsult



Yen-Kai Chen (New Zealand)
Membership co-Ordinator
Space biology and ecology



Nazmus Sadat (Bangladesh)
SMLS Newsletter lead
Remote sensing/ JAXA disaster management



Dr Zhen Cahilog (UK)
Research lead
F1 Medical Doctor Imperial



Dr Karoly Schlosser (Hungary)
Research lead
PhD student, Space psychology



José Gonçalo Teixeira Alves (Portugal)
Events and outreach
Medical student, CEMCA lead



Dr Fred Hill (UK)
Events and outreach
Medical doctor, CASE



Jules Lancee (Netherlands)
Webinar coordinator
Innovation, Digital health

Section 1: Community Engagement Metrics

Below is a list the key measures of our impact as a project group on our community:

- Growth of our online community on Slack **by 125% to 322 members**, with **over 6,573 messages sent** in the community. **30% of members are active weekly**, an **increase of 250%** compared to the same time last year.

Our Slack community is an online platform for members to participate in interactive and invigorating discussions on issues relating to space medicine. This forum has empowered members to share events, research, funding, and job opportunities relevant to space medicine and life sciences. [Figure 1]

- Growth of **our newsletter subscribers by 163% to 527 subscribers**. Thirteen communications were sent this year through the newsletter, including seven newsletters. Table 1 lists the email engagement metrics throughout the year.
- Public engagement through a number of social media channels.
 - Twitter: **696 followers, an increase of 173% from last year**. Up to 10.4k tweet impressions per month and 718 profile visits per month.
 - Facebook: **474 people who liked the site and 493 followers**.

Apart from developing our community-building infrastructure, our project group has also organised a number of events and projects throughout the year as foci of engagement. These are divided on our three focus themes of events and outreach; continuing professional development; and research. These areas are discussed further in the rest of this annual report.

Figure 1: SMLS Slack community figures

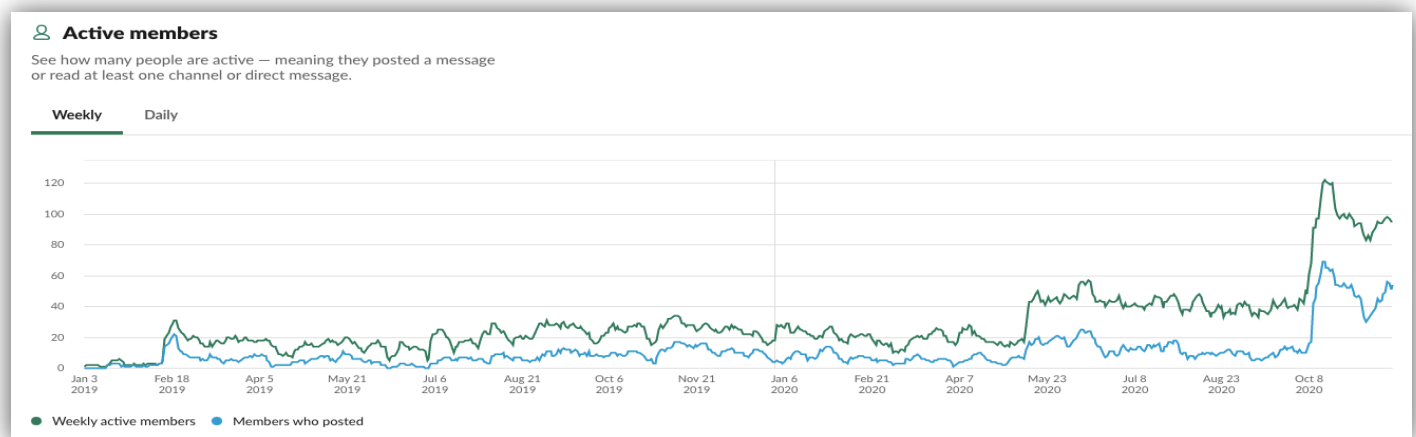


Table 1: SMLS Email engagement metrics

Campaign	# of Recipients	Open Rate	Click Rate
February Newsletter	224	24.6%	8.0%
April Newsletter	323	28.5%	13.9%
HIS: Episode 4	356	57.9%	17.4%
HIS: Episode 5	441	40.6%	7.5%
June Newsletter	449	26.5%	6.5%
July Newsletter	480	21%	5.2%
August Newsletter	516	28.3%	6%
September Newsletter	547	27.5%	5.9%
Systematic Review Webinar	537	41.4%	7.8%
Essay Competition	542	40.4%	2.8%
Life Sciences Webinar	564	39.9%	3.9%
Life Sciences Webinar (2)	573	38%	3.5%

Section 2: Events & Outreach

Despite the limitations imposed by COVID-19, the SMLS group continued to leverage our expertise in virtual events to deliver engaging events directly to our members that are accessible throughout the world.

Health in Space Webinar Series

Our highly successful *Health in Space Webinar* series continued in 2020. Each webinar episode showcased an international space medicine or space life science expert to talk about their work, paired with a young professional about their work in the same field and how they got involved. Through this webinar series, we hope to expose budding students and young professionals to the variety of opportunities in the field, and to inspire them to pursue a space or STEM related career.

Episode 3: State of the Art Spacesuit Design

Date: 11 February 2020

Description: Our third episode will focus on state of the art space suit design. How do we keep people alive in the extreme environment of outer space? What are solutions already in the making and what do we still fantasize about? Our stellar panel will talk about this and more... At the end of the session we will open it up to the audience, so you can ask questions to our panellists!

Speakers: Ana Diaz Artiles, Ryan L. Kobrick

Registrations: 116

YouTube views: 184

Link: <https://youtu.be/sxbBP11BR5o>

Episode 4: The Mission of the Crew Medical Doctor

Date: 29 April 2020

Description: Our fourth episode will focus on what it is like to be a Crew Medical Officer. How do you lead your team into a healthy mission? How do you deal with the limitations and opportunities of being in space, when it comes to health and medical needs? Our stellar panellist truly has been in outer space and will talk about this and more... At the end of the session we will open it up to the audience, so you can ask questions to our guest yourself!

Speaker: Astronaut Dave Williams

Registration: 188

Recording not available as speaker declined to be on YouTube.

Episode 5: Women's Health in Space

Date: 23 June 2020

Description: Our Fifth Episode will focus on Women's Health in Space. Space affects some aspects of male and female astronaut physiology differently. For example, on return to Earth, male astronauts have more problems with their vision whilst female astronauts have more issues with blood pressure management. Dr Varsha Jain is a space gynaecologist trying to find out why these gender differences occur. Dr Varsha Jain and Dr Virginia Wotring have collaborated to evaluate whether different hormonal therapies affect clot risk in female astronauts. Their latest paper has just been published in NPJ Microgravity. This stellar panel will discuss this and at the end of the session we will open it up to the audience, so you can ask questions to our panellists!

Speakers: Varsha Jain, Virginia Wotring
Registration: Views on Youtube: 285
Link: <https://youtu.be/VvmvHCHbgVA>

Additional SMLS Webinars

Our project group also diversified our webinars into other space life sciences topics, these are outlined below:

Space Life Sciences: An Insight from the United States Webinar

Date: 16 October 2020

Description: The past decade has brought us to the miniaturisation of electronic components. This has dramatically reduced the cost to make satellites and has allowed smaller nations and companies to engage in space-related services and research. However, space research and exploration cannot be without its biological components. This webinar series aims to bring the latest space biological knowledge to students and young professionals.

Speakers: Simon Gilroy, Elba Serrano, Parul Gupta, Kuang-Han Ke
Sponsors: Gran Systems
Registration: 55
Recording not available yet.

UK Space LABS and SGAC SMLS Spring Conference

Date: 23 April 2020

Topic: Returning to the Moon, Implications

Description: The last time humankind flew beyond lower Earth orbit and to the Moon was during the Apollo 17 mission, in 1972. Since then, as a species we have not returned to the Moon, despite multi-national interests in setting up lunar bases. NASA's Artemis programme aims to put "the first woman and the next man" on the Moon by as early as 2024, with the aim of establishing a presence on the Moon, and using it as a way of eventually putting humans on Mars. Yet, the implications of an extended stay on the Moon on human health are yet to be explored in great detail. How would flying and setting up for months or even years at a time effect human physiology and psychology? What risks does this next step in human space exploration pose to our bodies, and are the risks worth it?

This UK Space LABS/SGAC webinar event aims to explore these questions and also provide the opportunity for your questions to be answered by a variety of experts in the field, who each have experience in space related research, and will offer fascinating talks on a range of topics, from remote monitoring of astronaut health, to the psychology of coping in extreme environments.



- Speakers: Dr Jo Bower, Dr Floris Wuyst, Lauren Church, Professor Simon Evetts:, Bjorn Baselt.
- Registration 145
- YouTube Views: 194

UK Space LABS and SGAC SMLS Autumn Webinar pending

Date: 28th November 2020

Topic: Space and Terrestrial Health & the Case for Space Biosciences Innovation in the UK

Description: This event aims to showcase research, and explore how we can utilise innovation in space life and biological sciences for terrestrial benefit. As part of this webinar an update will be provided on work being led by UK Space LABS on the development of a key reference paper entitled: Why Space? The opportunity for the Health and Life Science Innovation.

Speakers: Lucas Rehnberg, Myles Harris, Julia Attias, Steve Harridge, Phil Carvil

Collaborator: UK Space Labs

SMLS @ SGAC events

We also supported SGAC mainline events by providing expertise, leading working groups, or referring Subject Matter Experts on space medicine and life sciences. The project group led Working Groups at the following SGAC events.

Space Generation Summit 2020

Dates: 5 - 8 November 2020

Tackling the COVID-19 Pandemic using Space Technology - Breakout Group

Our passion for space has always led us to look towards the stars. Time-and-time again however, we are reminded of our fragility onboard "Spaceship Earth". As the COVID-19 pandemic continues to create tremendous disruption and challenges to every health, social, economic, and environmental aspects of life of everyone on Earth, space technology has a vital role to play in addressing this global crisis. Our breakout group will draw inspiration from the Semi-Finalist essays of the recent SGAC SMLS and UKSpaceLabs essay competition on "How would you address the COVID-19 pandemic using a space application / technology?", and explore with real examples, the immense impact space technology can have on Earth today during this pandemic.

Asia Pacific Space Generation Online Workshop 2020

Dates: 28 - 29 November & 5 - 6 December 2020

Addressing Global Health (specifically COVID-19) with Space Medicine on Earth

When medical facilities are not readily available, such as in remote and underdeveloped regions, the standard of diagnosis and care have to be modified according to the context and constraints of such low-resource settings. Located more than 400km away from Earth,

astronauts in the International Space Station (ISS) have been utilizing medical technologies developed to accommodate various medical conditions and perform complex procedures efficiently and remotely. Through the years, some of these technologies, such as telemedicine, portable ultrasound units and ventilators, have been used to make medical care more accessible. In times of global health issues, such as the COVID-19 pandemic, use of such technologies can help empower local healthcare providers to provide more timely and efficient diagnosis and care.

Essay Competition

Finally, we also partnered with our SGAC Scholarship and Competition team to host an Essay Competition.

SGAC SMLS and UK Space LABS Essay Competition

Theme: How would you address the COVID-19 pandemic using a space application/technology?

Competition Entries: 10

Prizes:

- UK Space LABS Essay Competition Award: 1st place £100; 2nd and 3rd place £50 each towards conference fees.
- Top 3 ideas will be invited to publish in the SMLS and UK Space LABS newsletter and are invited to present at the Space Generation Summit 2020
- SMLS will provide platform and resources to develop and bring your idea to life

Sponsorship: UK Space LABS

Section 3: Professional Development

In 2020, to support the growing demand from members on professional development resources due to impact on education from the COVID-19 pandemic, our project group started several initiatives to deliver professional development and education activities virtually. These include the following:

The Systematic Review Workshop in Space Medicine & Life Sciences (Ongoing)

Date: September 2020 to April 2021

This is a collaboration between SMLS and UK Space LABS and Aerospace Medicine Systematic Review Workshop. We are hosting a virtual global workshop on Systematic Review in Space Medicine & Life Sciences. Shortlisted participants in the workshop are divided into 9 teams of six members each and are partnered with a renowned expert in the field of space medicine or life sciences. Based on their expert's field of expertise, the team then conducts a hands-on systematic review based on a particular research question over six months virtually. The workshop teaching staff provides methodological education throughout the six months, as well as close mentoring of the teams alongside the experts. The aim of the workshop is for each team to produce a systematic review manuscript that will be submitted and published in a peer-reviewed journal at the end of the workshop.

The poster for the SGAC Systematic Review Workshop features a dark background with white and blue text. At the top, it displays the logos for the Space Generation Advisory Council and UK Space LABS. The main title is 'SGAC SYSTEMATIC REVIEW WORKSHOP'. Below the title, a central box states: 'We have a fantastic line-up of mentors and topics! Submit your topic preferences by 3rd October 2020!'. The poster is divided into nine sections, each with a topic, a list of key questions, and a mentor's name and photo. The topics and questions are: 1. 'Effects of gravity on the human brain and behavior' (Dr. Elisa Raffaella Ferra): How does altered gravity influence human behavior and mental health? How does altered gravity affect our physiological, neural, and psychological processes? 2. 'Osteoporosis pharmacological treatment on bone health in bed rest studies' (Dr. Li Sheen Toh): What pharmacological options are used to treat osteoporosis? How effective are they, especially in bed rest studies? How might these pharmacological options be useful in spaceflight? 3. 'Spaceflight training and preparation for commercial participants' (Prof. Simon Evetts): How do we identify and recommend the minimal space training standards for commercial spaceflight participants? 4. 'Possibility of human hibernation in future spaceflight systems' (Dr. Peter Hodgkinson): What is known about mammalian and human hibernation? How does this physiological state behave under environments of microgravity and increased ionizing radiation? 5. 'Health and Life Science in Space, the opportunity for innovation' (Dr. Philip Carvell): What health and life science innovation activities are carried out in space? How can we use current infrastructure to solve research and development challenges? 6. 'Suborbital spaceflight: a review of the physiology and medical requirements' (Dr. Peter Hodgkinson): What are the effects of suborbital spaceflight on the human body? What equipment and medical support are required for suborbital spaceflight? 7. 'Legal and ethical concerns in spaceflight and aerospace activities' (Dr. Chris Deaury): What legal and ethical issues emerge with the advent of human spaceflight and aerospace activities? (e.g. consent, discrimination, research, rights) 8. 'Radioprotective measures and DNA damage from spaceflight' (Dr. Christopher Mason): How does space radiation during spaceflight affect DNA? How can we protect DNA from being damaged by space radiation? 9. 'Digital solutions for spaceflight crew behavioral & mental health management' (Dr. Nathan Smith): What digital training and interventions have been used in space, with respect to psychology and mental health? What are the best practices for developing such digital solutions for spaceflight? At the bottom, it provides social media handles (@SGAC_SMLS, @UK_SpaceLABS) and contact information for queries (ukspacelabsengagement@gmail.com).

Applications Received: 130
Participants Chosen: 54

SMLS Systematic Review Launch Webinar

Date: 19 September 2020

The Systematic Review webinar is a collaboration between SGAC SMLS and UK Space LABS, aiming to attract those with an interest in learning more about systematic reviews, particularly in the context of space medicine.

Systematic reviews are a type of literature review that enables researchers to review research and data from published studies in a standardized way. Their use in the field of space and aviation medicine needs to be explored, which is the purpose of this webinar. This unique webinar aims to introduce the audience to the methodologies of systematic reviews and how to conduct them, and then looking at how systematic reviews have been conducted in the space medicine sector, with published examples.

Speakers: Rochelle Velho, Jonathan Laws, and Anthony Yuen

Collaborator: UK Space Labs and Aerospace Medicine SR Group NU University

Registration: Views on YouTube: 199

Link: <https://youtu.be/kVdFD13DpuQ>

SGAC SMLS and SEPG Mentorship Webinar

Date: 9 June 2020

Description: Meet the leaders of the Space Medicine and Life Sciences and the Space Exploration Project Groups, and find out how to get involved!

Speakers: Rochelle Velho, Illaria Cinelli

Registration: Unknown number

Section 4: Research & Projects

The SMLS Project Group supports a number of ongoing initiatives and projects throughout the year to provide opportunities for members to do hands-on work related to the field of space medicine and life sciences.

Research so far

Project 1: UNOOSA Space for Global Health Working Group Questionnaire, a collaboration with the UN Working Group

SMLS members participated in submitting a reply to the UNOOSA Space for Global Health Working Group 2020 questionnaire.

Progress: Submitted and awaiting final report from working group.

Project 2: NASA Space Apps Challenge for COVID-19

SMLS members participated in the NASA Space Apps challenge for Covid 19. This project is ongoing and the preliminary report and slides are linked below. Link to NASA Space Apps: <https://www.spaceappschallenge.org/>

Progress: Ongoing

Description: NASA Space Apps Challenge 2020 (Human Factors category): “The emergence and spread of infectious diseases, like COVID-19, are on the rise. Can you identify patterns of population density and COVID-19 cases and identify factors that could predict hotspots and disease spread?”

Following the submission of the project proposal, the team remained connected and the project evolved beyond the challenge. The solution we are in the process of building involves the development of a model that forecasts COVID-19 cases by linking satellite observation air pollution data to social distancing adherence, which is currently being prepared for submission to The Lancet Public Health journal. Our group consisted of six early investigators that spanned multiple disciplines that included medical physics and engineering, public health, life sciences, space medicine, emergency medicine, intensive care medicine, and microbiology. Three of our members were early career frontline physicians that are part of the frontline response to COVID-19 based in the UK and US; who have seen the impact of COVID-19 cases overwhelming a medical system and limiting appropriate resource allocation.

Team Slides: <https://drive.google.com/file/d/11Zvo0ay6Ldq7DEtnH3rnbGH-64M0YQf8/view?ths=true>

Team Report on NASA Space Apps website:

<https://covid19.spaceappschallenge.org/challenges/covid-challenges/human-factors/teams/novidien/project>

Project 3: Mars Society Project

SMLS mentors and members participated in a joint group project submission for a competition to design a Mars City coordinated by the Mars Society. This was in collaboration with other PGs within SGAC and led by members of the SEPG PG.

Progress: Ongoing. An abstract has been submitted to AsMA 2020.

Description: The Mars City Design Project is still ongoing: the work is being collated into a report for the Mars Society and the SMLS members have submitted the medical perspective to the AsMA 2020 conference as an abstract.

Link: <https://www.marssociety.org/news/2020/09/28/finalists-chosen-in-mars-city-state-design-competition/>

Project 4: Twitter Space Life Sciences Journal Club

Critical appraisal of the latest scientific papers in aerospace medicine and life sciences was done via Twitter with our members and advertised on Slack as well as our newsletter.

Progress: Ongoing, every 2 months on Twitter.

Link: https://twitter.com/SGAC_SMLS/status/1279127211598020608

Project 5: Systematic Review with NASA ExMc

NASA Human Research Program Exploration Medical Capabilities Element project with members of SMLS. The focus is on atmospheric factors and the impact on the degradation profile of pharmaceuticals in space.

Progress: Ongoing. An abstract has been submitted to AsMA 2020.

Ongoing Research Focus

At present, the project group is supporting a series of SMLS-led research projects, which are in their preliminary phase. These include:

- Non-invasive measurement of intracranial pressure, a spin-off project from our European Space Generation Workshop Space Medicine Track.
- Covid-19 Space for Health Essay prize winners and SGAC Summit team project

Future Research Focus

In terms of research, we are also in the process of generating guidelines and best-practice pathways for interested individuals or groups to conduct space medicine and life sciences research. We also would like to expand this area to provide research pipelines for students or early investigators to engage with experts on a virtual forum, translating our lessons learnt from the SR Workshop hosted on Google Classroom and #Slack.

External Representation

Finally, in the area of external partnerships and collaboration, we have been in early discussions with a number of established groups in the field to look at potential opportunities for synergies. Our current standing partnerships include the United Nations Committee on the Peaceful Uses of Outer Space - Space and Global Health Working Group. We have also drafted a Memorandum of Understanding with Innova space, which is currently under review, and are in the early phase of discussing MOUs with RAES Next Gen, UK Space LABS, and AsMA AMSRO.

Forward view

So overall, this report outlines our core project group activities for 2020. We endeavour to build on these preliminary outputs to widen access to aerospace medicine events, research and careers on a global level; which aligns with the objectives of SGAC.