Appendix B

Additional Concepts Discussed

Global

1. The continuum of care that was verbalized by SCCM's founders will be realized. Critical care will start as close to initial illness or injury as possible and continue through the post-ICU space.
2. Care should be identified that enhances value and eliminates waste, as critical care will be even more expensive than it is now.

Technology

3. AI is fully integrated into day-to-day patient care. The EMR is replaced by a virtual assistant that moves with the intensivist, sees what we see, integrates data, and provides real-time diagnostic and therapeutic guidance. AI gives immediate feedback about the potential efficacy and risks of therapeutic plans. It records our impressions and actions; reducing, if not eliminating, the need for written documentation.
4. Medical information, including genetic mutations and single-nucleotide polymorphisms (perhaps entire genome sequences) will exist on small plastic smart cards or smart phone apps to guide each therapeutic decision and anticipated response.
5. Fully integrated, international, universal EHRs will accommodate the jet-setting/spaceship-traveling lives of people in the future
6. Wearable, implantable sensors (continuous biomarkers) to detect impending pulmonary embolism, myocardial infarction, stroke, and infection that is integrated with EHR data for a comprehensive assessment of risk will increase emphasis on prevention rather than treatment.

7. Machine learning prediction tools using all variables in the EHR will be specific to gender, as well as multi-race and multi-ethnic-specific.
8. Tele-critical care will be available in any location to provide real-time evaluation and guidance anywhere in the world.
9. Surgeries will become increasingly minimally or noninvasive, reducing surgical ICU volumes.
10. Critical care will overlap with bioengineering and will require expertise in troubleshooting and perhaps repairing a growing array of implanted and extracorporeal artificial organs and support devices.

ICU Environment

11. ICU care will be delivered by mobile care units (critical care without walls) that provide all high-acuity care including surgical services via robotic surgery. The goal will be to keep the patient in the community close to family and relevant support system.
12. The ICU bed will perform all care functions, including physical therapy, nutritional support, radiology examinations, and titration of medication.
13. The ICU bed will not be horizontal but rather vertical to enhance mobility and will convert to a horizontal at night to promote the day/night sleep cycle.
14. A shift to disease prevention will reduce illness, including critical illness, thus alleviating staffing shortages.
15. Enhanced linkage of patients to social networks through technology will allow for global advances to optimize care (enhanced holograms or 3D Zoom meetings).
16. The ICU room will change based on the patient's preferences (personalized environment for recovery).For example, forest, sea, or urban settings can be programed for background effect in the room.

17. The ICU environment will become unconventional and able to deliver anywhere—critical care in space, on extraterrestrial locations such as the moon or Mars, critical care under the sea, especially at depth and under pressure.

Advanced Therapies

18. National, international, and universal strategies for dealing with disasters affecting large populations will be designed and implemented.
19. One pill for everything- correct dose, correct release time, correct combination. The pill will be so personalized that patients will need to ingest only one pill for all medicinal needs. Concerns for adherence will be eliminated.
20. Drug shortages will be eliminated with 3D printing.
21. Targeted drug delivery with genetic innovation will mitigate adverse effects because the drug will be delivered only to the intended cell or site of action.
22. Disease prevention and treatment with gene editing will reduce the need for pharmacologic treatment.
23. Closed-loop titration will exist for for anxiolysis, analgesia, mechanical ventilation, and vasoactive-inotropic support.
24. Facial recognition software will provide constant surveillance and help titrate pain and sedation medications based on learned cues of pleasure, anxiety, calmness, and pain from home, work, and leisure environments while avoiding withdrawal and delirium.
25. Lifespans will extend markedly as regenerative medicine, tailored pharmaceuticals, nanotechnology, 3D printing, and other technologies evolve.
26. There will be cross-species biotherapeutic development.

27. Optimal therapeutic efficacy will be achieved for all patients equally with gender, multi-race, multi-ethnic, and genetic-specific research and technology to guide advanced therapies.
28. Pain-centered opioid abuse will be a minor concern because of preventative medicine, minimally invasive surgery, pain sources improved with regenerative medicine, cross-species biotherapeutics, and personalized recovery.
29. Post-intensive care syndrome will no longer exist with the reduction in critical illness, advanced treatments, and prehabilitation/rehabilitation.

ICU Team

30. Integration of the family into the team will be seamless with automatic notification and direct connection to the family with telecommunication. Families can monitor the patient's vital signs, medication, and progress from afar. Families will be able to control the room environment so they can talk to the patient, play favorite music, or turn off the lights for a soothing environment.
31. Tele-physical, occupational, and cognitive therapy will provide seamless care across the continuum of acute illness and recovery. These therapies will adapt to the patient's response. Therapies that are more effective will be maximized with detailed information provided by sensored monitoring.
32. The critical care team will involve advanced robots or cyborgs so that in a highly infectious situation or pandemic, a human is never required to be present in the room, but the interdisciplinary team can control the actions with automated assistance.
33. Palliative care as part of human care will be highly personalized and completely directed by the patient and family members. The patient will be provided precise data to assist in personalized decisions.

34. Critical care will include prehospital and post-hospital clinicians to extend the continuum of care.
35. Mobile ICUs will respond similar to ambulances but with imaging and technology available for diagnosis of time-sensitive conditions such as acute myocardial infarction or stroke and initiation of treatments such as catheterization and surgery as early as possible.

Education and Training

36. Simulation training will not be additive but will be the center of all interdisciplinary learning.
37. Professional societies will expand the collaborative model of learning activities.
38. Interprofessional education will begin during graduate studies to combine all learners into one space.
39. Critical care education spans a global audience virtually and in person simultaneously.
40. Updates in clinical guidelines are translated immediately into educational modules so that the professional can adapt practice in real time.

Research

41. Large-scale data systems will be able to identify researchers who are working on similar projects, globally allowing for collaboration instead of duplication.
42. AI algorithms will assess patients individually for a multitude of potential local, national, and global research studies that could be conducted simultaneously during a patient's stay.
43. Real-time generation of dashboards, graphics, and reports will be understandable to the general population, enhancing consumption of information.
44. Data will be analyzed in real time (living guidelines) and clinicians given real-time updates to guidelines.

45. AI- and model-based research will be fundamental.
46. Holograms will consent patients for studies and will also conduct interviews for research projects.

Patient Care, Patient Population, Bedside

47. Autonomous vehicles will nearly eliminate road accidents, and robotic or remotely operated devices will assume many dangerous jobs that previously put people at risk. Trauma units will be empty, but this is offset by increases in serious tropical diseases and pandemics provoked by climate change and travel. Serious environmental mass casualty events (due to heatwaves, air pollution, natural disasters, etc.) will become more frequent. Critical care surge capacity will become an ongoing need and concern.
48. Patients will have clearer advance care planning documents and discussions with documentation facilitated and available to all clinicians across diverse platforms, which will enable patients to avoid ICU admission if it is not within their goals of care and/or to make their goals of care clearer to the ICU team during treatment.