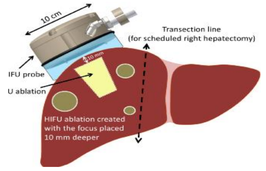
The Future of Surgery – '*Black Swans*' and Avoiding Technological Surprise

This is about "the ***unknown unknowns*** – [things] we didn't know that we didn't know"
Secretary of Defense Donald Rumsfeld, Department of Defense briefing, February 12, 2002

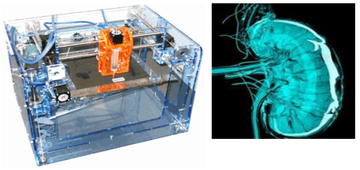
The phrase "black swan" derives from 2nd-century Roman poet Juvenal who described a black swan which was presumed not to exist. In 16th century science in London, "all swans must be white because all historical records of swans reported that they had white feathers' – unknown, unpredictable, impossible events which did occur – or unknown unknowns.

Although a few laparoscopic procedures had been reported in first half of 20th Century, it was not until the 1980's that surgeons 'discovered' laparoscopic surgery and another decade before it was widely accepted and implemented.

A few examples of these previously unknown, unknown technologies



High intensity Focused Ultrasound (HIFU) ablation of tumors with on-invasive , non-ionizing ultrasonic energy.



3-D printed organs. Using patient derived stem cells (from biopsy), to 'print' a patient organ (example, kidney) for a transplant which will not be rejected nor require immunosuppression.



Thought-directed surgery. Using your thoughts rather than your hands to direct the performance of surgery. As the Brain Mapping Project continues, more thought-control of devices will emerge.

Challenges: Exposure to a greater spectrum of technologies, especially in non-healthcare sciences
Increase development/approval (through simulation?) to accelerate commercialization

Conclusion : There are numerous non-healthcare technologies, like new 5G telecommunications, that can totally revolutionize the practice of surgery