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Arkenea: Do you think the future of healthcare delivery would primarily be based out of individual's homes?

BioEnginuity: Yes. Healthcare services are moving out of the hospital and into the community in an era of emerging patient empowerment. Technology and medical innovation will increasingly provide the opportunity to broaden access to care, either through telemedicine platforms or the mobile delivery of medical goods and services. Relaxed barriers to market entry through streamlined regulatory policy as well as the creation of new healthcare

finance models may fundamentally change the way healthcare is delivered in the United States. Medical knowledge is not as siloed as it historically has been, even up to the turn of the century. As a result, the notion of the physician high priest acting as sole purveyor of inaccessible information has largely been disbanded and will be replaced by an empowered patient population, capable of playing a more active role in their own wellbeing. The need for adequate patient education will remain however. Preventive and Precision Medicine may increasingly drive care delivery and financial models, as medical intervention is pushed upstream to promote wellness proactively. Finally, addressing social determinants of health outside the hospital aims to reduce disparities in healthcare, improve clinical outcomes and ease the financial burden on overloaded healthcare systems.

Arkenea: Which technologies will shape the future of healthcare delivery and in what ways?

BioEnginuity: The availability of an effective COVID-19 vaccine will certainly shape the future of healthcare delivery, as secondary (untreated chronic illnesses) and tertiary (psychosocial) coronavirus health impacts will remain unresolved until vaccines are widely available. The pandemic has solidified the adoption of telemedicine services, which are quite likely here to stay, as virtual visits are trending to exceed in-person visits in the near future. With transformation from in-person clinic visits to remote, virtual visits, integrative technologies such as 5G networks, interoperable EHR systems, artificial intelligence (AI) and machine learning (ML) services, augmented reality (AR) and virtual reality (VR) solutions, as well as wearables that collect and share personal health data, all stand to critically impact the future of healthcare delivery. Direct-to-consumer services also have the potential to strengthen patient investment in their own wellbeing. For example, home drone delivery of prescription medications, the availability of reasonably priced whole genome sequencing and mobile imaging platforms capable of deployment into local neighborhoods each may promote community-based healthcare delivery.

Arkenea: According to you, what would be the impact of VR and AI on the future of health?

BioEnginuity: Virtual Reality stands to impact the future of health most immediately in an educational context, whether through adoption in pre-operative planning or in physician didactic training. The future of the anatomy lab may look quite different than it does in current day medical school curriculums. Similarly, preoperative planning without a VR case review may someday be unheard of. VR and spatial computing solutions may be used in both therapeutic and environmental contexts. VR is currently being explored as distraction therapy, and may some day make its way into pain management or palliative care regimens. Future state telehealth consultations may take place in a virtual medical clinic, where avatars serve as proxy to patient presence in a community health center or hospital. During such visits, clinicians may access imaging studies or patient reports that can be discussed in real-time in the VR environment. Additionally, the future lends itself to the possibility of a digital twin, where fully transcribed genetic and epigenetic risk factors, mutiomic data sets and/or 3D tumor models are reviewed between doctor and patient.

Artificial Intelligence will be a mainstay within the next decade. AI computational power that exceeds human capabilities might be leveraged within healthcare to increase precision of diagnosis, accurately predict the onset of future disease states, and if used appropriately, enhance the humane interaction between doctor

and patient. Repetitive tasks such as radiological image analysis lends itself to robotic process automation (RPA), though human interpretation and governance will still be needed to provide context. Automation in medical robotics, an explosion of personalized health data through wearables and smart clothing, enhanced quality of life via the quantified self, and a blurring of the lines between the physical and digital realms may lead to a future health practice that looks quite different from our current state. AI shows tremendous potential but must first cross the chasm of proving clinical, financial and personal benefit to all parties involved in its use.

Arkenea: What would be the key goals/objectives of the future of healthcare delivery?

BioEnginuity: Increasing access to care in a cost-effective manner. Half of the world's population lacks access to basic medical services, according to the World Health Organization. Key goals and objectives for the future of healthcare delivery must therefore focus on increasing access to care for rural and underserved communities throughout the globe. The use of technologies such as digital health and mobile health services can assist with this objective, yet each runs the risk of further fracturing clinical outcomes by failing to address the digital divide. Furthermore, the delivery of effective care must occur within cost models that are equal and affordable to all segments of the population, a target made more difficult with widening of economic disparity. Coverage models that serve both the uninsured and the under-insured populations may necessitate progressive political discourse. Technology has the capacity to create a paradigm shift of upstream care delivery that prioritizes disease prevention and biopsychosocial wellness over reactive biological treatments, though financial and legal models may dictate overall effectiveness. As a result, new legal structures that allow physicians to perform their jobs within modern frameworks may be needed to minimise risks for litigative exploitation. Financial models, requiring government and private institutional sponsorship, can pave the way for a future state of healthcare where all segments of the population have access to basic medical services that truly promote personal wellbeing. In summary, new technologies, medicolegal and financial models must strive to address the quadruple aim of improved patient and provider experience, better outcomes and lower costs.

Arkenea: What challenges or roadblocks could come in the way of shaping the future of healthcare? Also, are there any ways to combat these challenges?

BioEnginuity: The design of healthcare financial models serves as a limiting factor for how effective the future of healthcare will be. Financial models that fail to fiscally support the promotion of basic medical services may instead serve only to further widen the gap between those with and those without, thereby undermining longevity. Promotion of digital health services might result in a future where access to care is broadened, but also might serve to marginalize segments of the population without access to basic technology. Similarly, an era of relaxed regulations must balance the need to approve innovative digital health applications (particularly those with evidence-based clinical benefit to patients) with the need to properly de-risk new tech as part of the diligence process. Legal frameworks that protect physicians during an exploratory phase of digital health adoption must also ensure that bioethical principals such as nonmaleficence and distributive justice are fully accounted for. Given the recent advances of medical technologies and an exacerbated adoption driven by the COVID-19 pandemic, the future of medicine is undoubtedly full of potential.