The Singularity

The Law of Accelerating Returns predicts an exponential increase in technologies like computers, genetics, nanotechnology, robotics, and artificial intelligence.

This will lead to a technological singularity in the year 2045, a point where progress is so rapid it outstrips humans' ability to comprehend it.

© AAVMC 2022

The Singularity

The Law of Accelerating Returns predicts an exponential increase in technologies like computers, genetics, nanotechnology, robotics, and artificial intelligence.
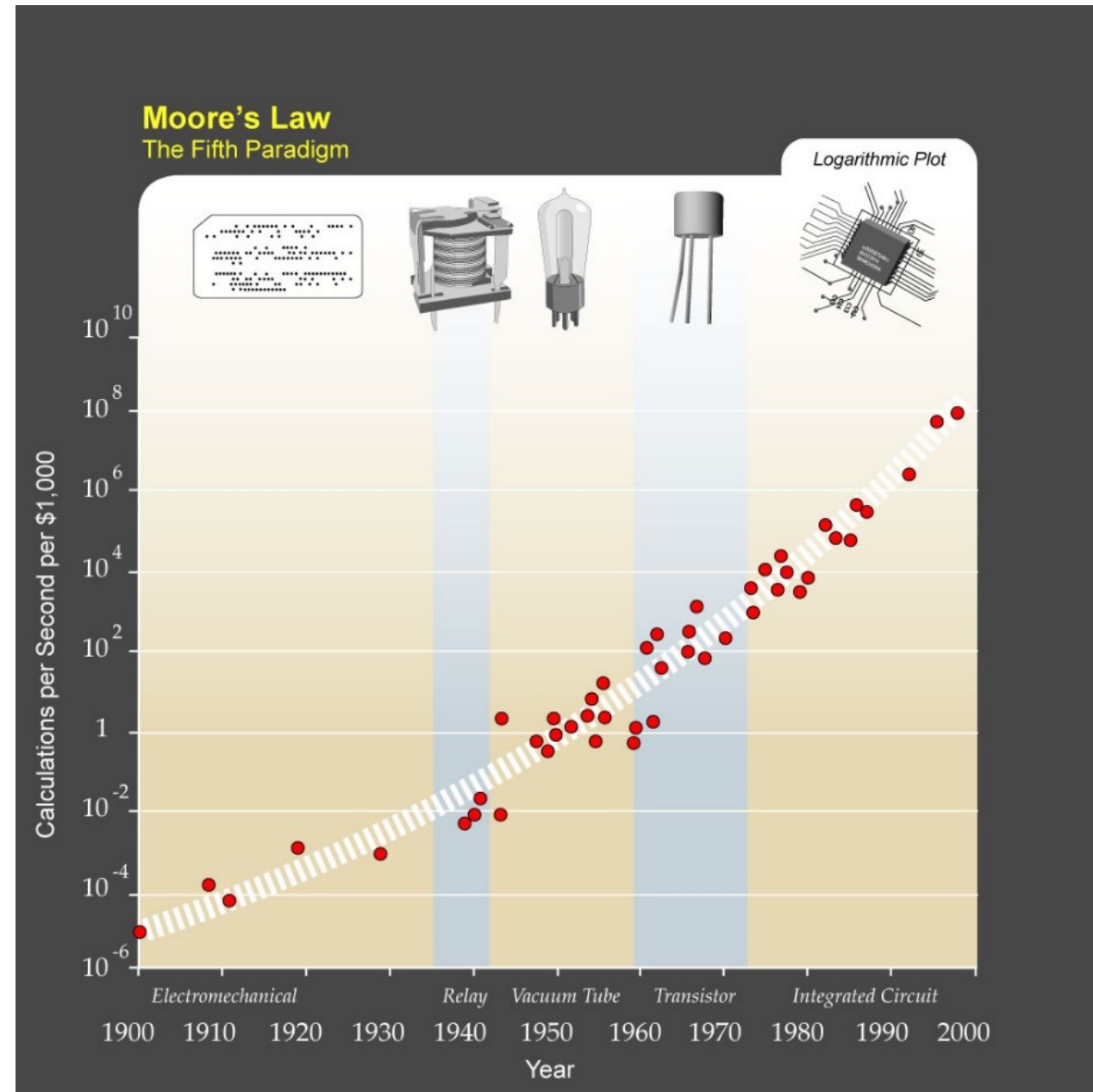
This will lead to a technological singularity in the year 2045, a point where progress is so rapid it outstrips humans' ability to comprehend it.

1 The accelerating pace of change …

Agricultural Revolution ←**8,000 years**→ Industrial Revolution ←**120 years**→ Light-bulb ←**90 years**→ Moon landing ←**22 years**→ World Wide Web ←**9 years**→ Human genome sequenced

2045 ← Surpasses brainpower equivalent to that of all human brains combined

10^{26}

2 … and exponential growth in computing power …

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years

COMPUTER RANKINGS
By calculations per second per $1,000

10^{20}

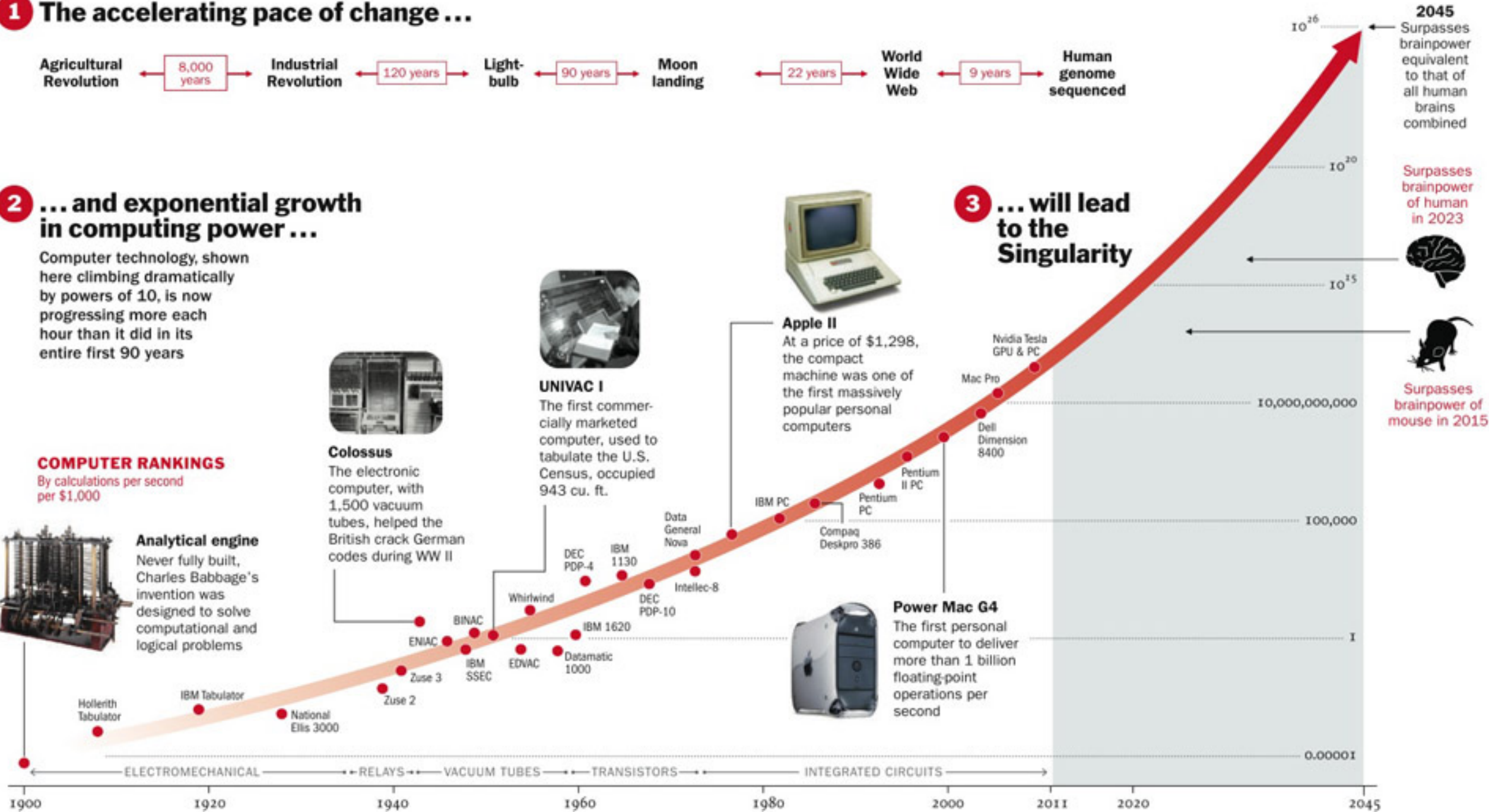Surpasses brainpower of human in 2023

10^{15}

3 … will lead to the Singularity

Apple II
At a price of $1,298, the compact machine was one of the first massively popular personal computers

Nvidia Tesla GPU & PC
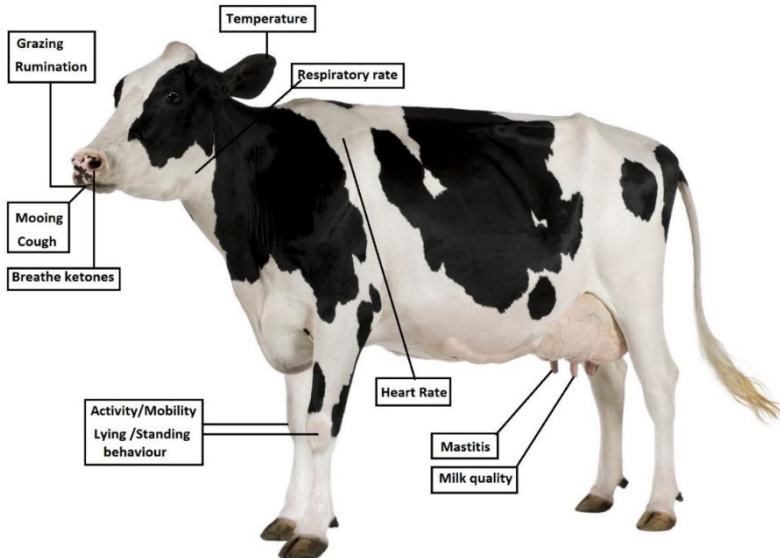
Mac Pro

Surpasses brainpower of mouse in 2015

UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.

Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II

Dell Dimension 8400

Pentium II PC

IBM PC

Pentium PC

Compaq Deskpro 386

10,000,000,000

Data General Nova

Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems

DEC PDP-4

IBM 1130

Intellec-8

100,000

DEC PDP-10

Whirlwind

IBM 1620

BINAC

ENIAC

EDVAC

Datamatic 1000

Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second

1

Zuse 3

IBM SSEC

IBM Tabulator

Zuse 2

0.00001

Hollerith Tabulator

National Ellis 3000

ELECTROMECHANICAL → RELAYS → VACUUM TUBES → TRANSISTORS → INTEGRATED CIRCUITS

1900   1920   1940   1960   1980   2000   2011   2020   2045

The Future of Healthcare

Telehealth & Telemedicine in Veterinary Practice

Telehealth has arisen as one of the greatest opportunities and challenges facing medicine in this digital age. Using telemedicine in the delivery of veterinary medical services offers benefits for animal owners, patients and the profession. However, veterinary services must be provided with professionalism and adhering to the same standard of care, whether delivered in person or through electronic means.

The AVMA is committed to ensuring access to the convenience and benefits afforded by telemedicine, while promoting the responsible provision of high-quality veterinary medical care.

Telehealth Basics

What is telehealth? How is it different from telemedicine? Know these and other definitions, and get answers to frequently asked questions about all aspects of veterinary telehealth.

Telehealth and the VCPR

Delivery of veterinary medical care requires the existence of a Veterinarian-Client-Patient Relationship (VCPR). Learn what compliance with the VCPR requirement looks like in the context of telehealth.

Steps to Implement Telemedicine

When deployed properly to support communication and care coordination, telemedicine may improve patient triage and clinical outcomes, and benefit patients, animal owners, and the veterinary practice. Follow these steps to implement telemedicine programs successfully in your practice.

Service Models for Veterinary Telemedicine

Telemedicine is not a one-size-fits-all proposition. You can customize your program and services to fit the needs of your veterinary patients, clients and practice. Here, we outline and compare a variety of existing service models.

Case Study

Learn from your colleagues' experience. Here's how one veterinary team increased client compliance with post-surgical and hospice care recommendations by augmenting in-hospital care with telemedicine services.

The Future of Healthcare
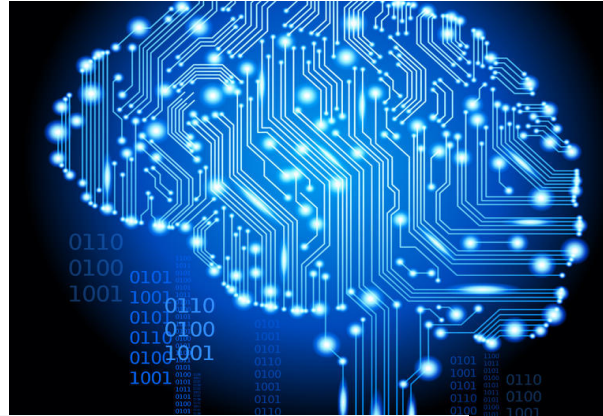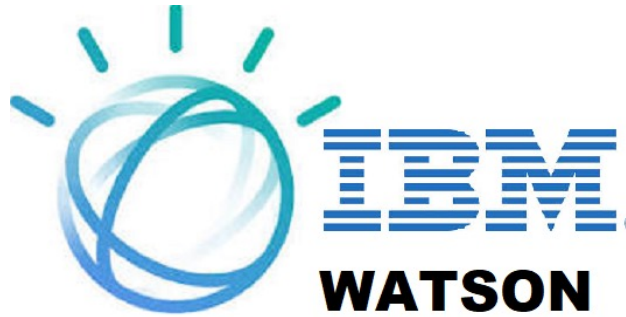
IBM WATSON

IBM Watson for Genomics

Bringing the promise of precision medicine to more cancer patients, Watson can interpret genetic testing results faster and with greater accuracy than manual efforts. Our partnership with Quest Diagnostics means that all providers can potentially benefit, regardless of access to in-house sequencing.

IBM Watson for Oncology

Spend less time searching literature and more time caring for patients. Watson can provide clinicians with evidence-based treatment options based on expert training by Memorial Sloan Kettering (MSK) physicians.

THE NEW YORKER

ANNALS OF MEDICINE   APRIL 3, 2017 ISSUE

A.I. VERSUS M.D.

What happens when diagnosis is automated?

By Siddhartha Mukherjee

The Future of Healthcare

Yomi® provides an unprecedented level of precision and control. Using haptic guidance and multisensory feedback, Yomi® helps you achieve the right location, angulation and depth to place the implant perfectly.

A robot implants 3D-printed teeth in a Chinese patient

A new age of autonomous robotic surgery is on the way, at least for some routine procedures

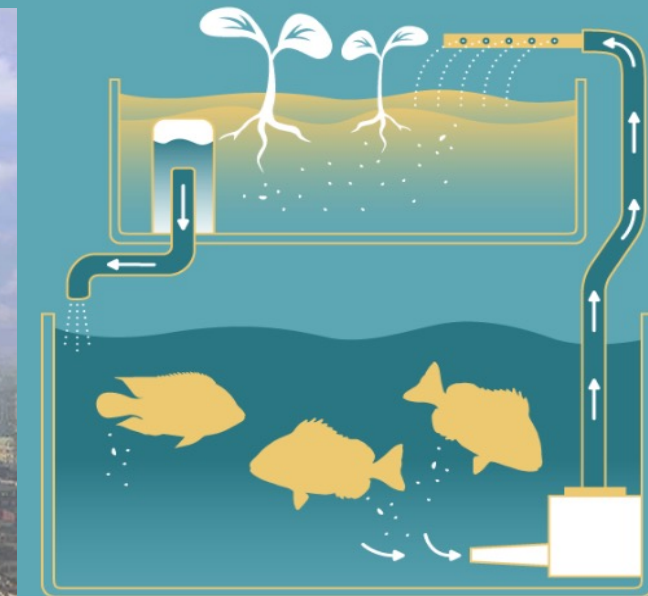By Greg Nichols for Robotics | September 25, 2017 -- 09:25 GMT (02:25 PDT) | Topic: Robotics

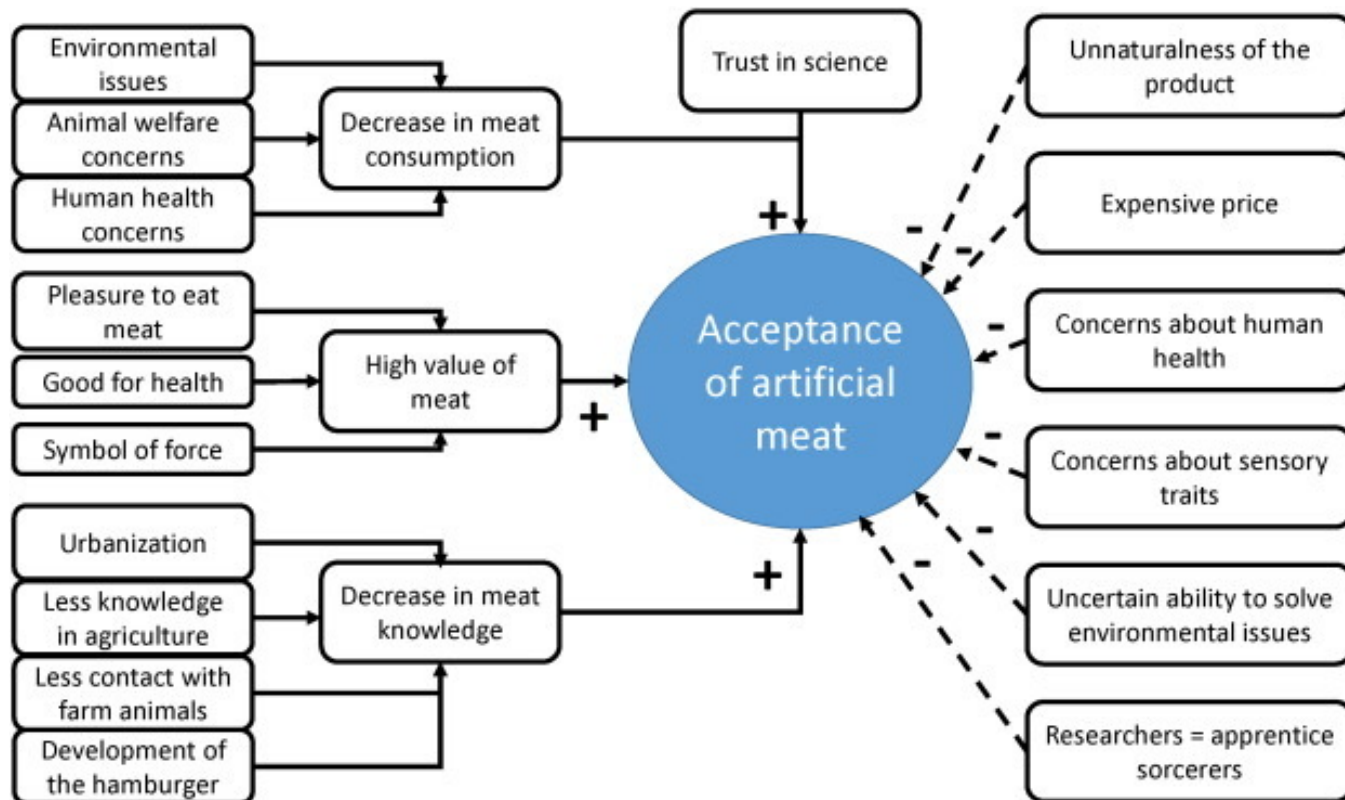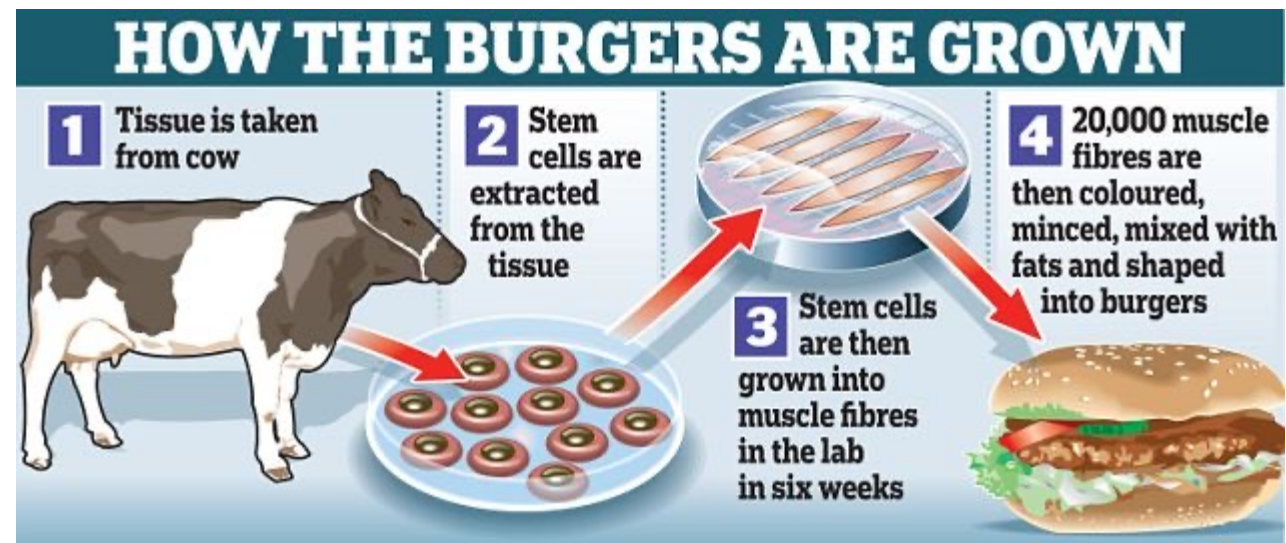The da Vinci Surgical System

The Future of Food

Aquaponics

Integration of fish farming (aquaculture) and soil-free agriculture (hydroponics) is a relatively new
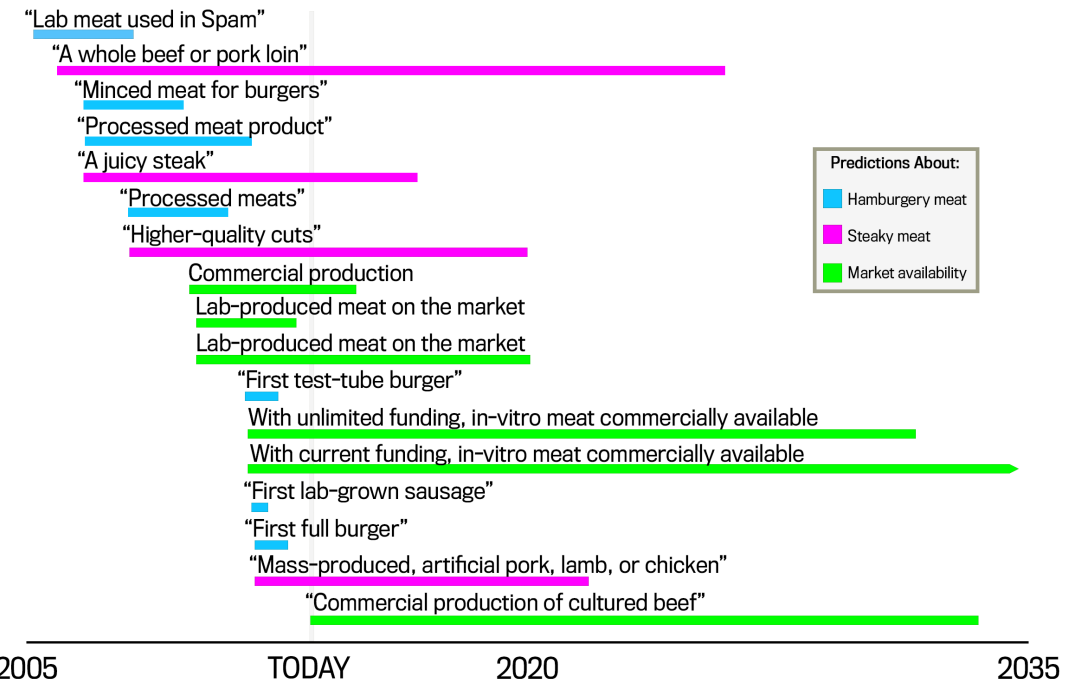
The Future of Food

HOW THE BURGERS ARE GROWN

1. Tissue is taken from cow
2. Stem cells are extracted from the tissue
3. Stem cells are then grown into muscle fibres in the lab in six weeks
4. 20,000 muscle fibres are then coloured, minced, mixed with fats and shaped into burgers

Environmental issues, Animal welfare concerns, Human health concerns → Decrease in meat consumption

Pleasure to eat meat, Good for health, Symbol of force → High value of meat

Urbanization, Less knowledge in agriculture, Less contact with farm animals, Development of the hamburger → Decrease in meat knowledge

Trust in science

+ High value of meat → + Acceptance of artificial meat
+ Decrease in meat knowledge → +

Acceptance of artificial meat → − Unnaturalness of the product, − Expensive price, − Concerns about human health, − Concerns about sensory traits, − Uncertain ability to solve environmental issues, − Researchers = apprentice sorcerers

In-Vitro Meat Predictions 2005-2035

"Lab meat used in Spam"
"A whole beef or pork loin"
"Minced meat for burgers"
"Processed meat product"
"A juicy steak"
"Processed meats"
"Higher-quality cuts"
Commercial production
Lab-produced meat on the market
Lab-produced meat on the market
"First test-tube burger"
With unlimited funding, in-vitro meat commercially available
With current funding, in-vitro meat commercially available
"First lab-grown sausage"
"First full burger"
"Mass-produced, artificial pork, lamb, or chicken"
"Commercial production of cultured beef"

Predictions About:
- Hamburgery meat
- Steaky meat
- Market availability

2005   TODAY   2020   2035

The Future of Food

Acheta Domestica

CRICKET FLOUR
100% Cricket flour made from Acheta domestica crickets

protein by weight

- 68% cricket flour, dry
- 43% beef jerky, dry
- 31% chicken breast
- 29% sirlion steak

bugsolutely

Soybean oil processing — Soybeanmeal

INPUTS
- Plant farming
- Animal farming
- Food production
- Energy
- Animal feed
- Manure
- Food waste
- Water

INSECT PRODUCTION AND FEED PROCESSING
- Killing (freezing)
- Drying
- Fresh prepupae ~ 60% moisture
- Defattening and grinding
- Mixing feed
- Black soldier fly larvae (*Hermetia illucens*) production
- Residual biomass low quality
- Residual biomass high quality

FOOD PROCESSING
- High moisture extrusion
- Insect meal ~ 60% protein 10% fat 10% moisture

WASTE TREATMENT
- Biowaste treatment
- Drying

OUTPUTS
- Meat substitute
- Insect protein powder
- Insect fat
- Fertilizer
- Fertilizer

- Seed larvae production
- Metabolic emissions

Legend:
- Waste (side) flows
- Resources flows
- Insect biomass flow
- Optional insect biomass flows

The Future of Companionship

About

Markets ⌄   Topics ⌄   Resources

EXECUTIVE BRIEFING   01/30/2018 11:00 pm ET

Is Loneliness The Overlooked Social Determinant?

By Sarah C. Threnhauser, MPA

Social Determinants of Health

Neighborhood and Built Environment

Economic Stability

Health and Health Care

SDOH

Education

Social and Community Context

The contribution of animals to human welfare
Scientific and Technical Review, Vol. 37 (1)

Temple Grandin, ed., 2018

habri
human animal bond
research institute

WE ARE THE HUMAN ANIMAL BOND RESEARCH INSTITUTE

HABRI believes in the powerful relationship between
animals and people and the impact of this relationship
on the health of individuals, families, and
communities.

How do we prepare today's students for an exponential future?
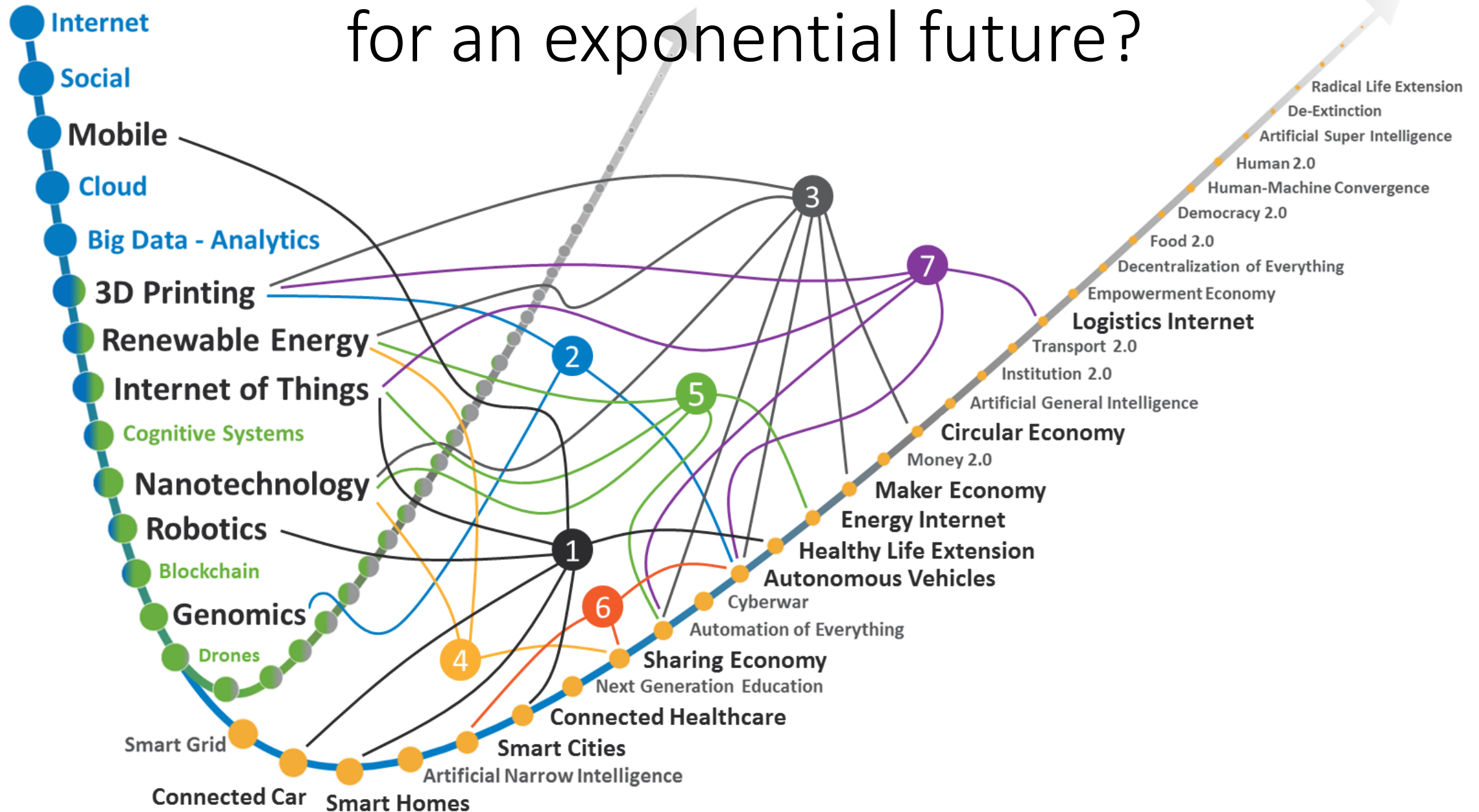
The Future of the Professions

- Expertise (specialized knowledge) is at the heart of the professions
- Knowledge is becoming increasingly democratized
- Technology will transform the work of human experts
- Increasingly capable systems will change the way expertise is made available

'A Financial Times Book of the Year'

RICHARD SUSSKIND   DANIEL SUSSKIND

THE FUTURE OF THE PROFESSIONS

HOW TECHNOLOGY WILL TRANSFORM
THE WORK OF HUMAN EXPERTS
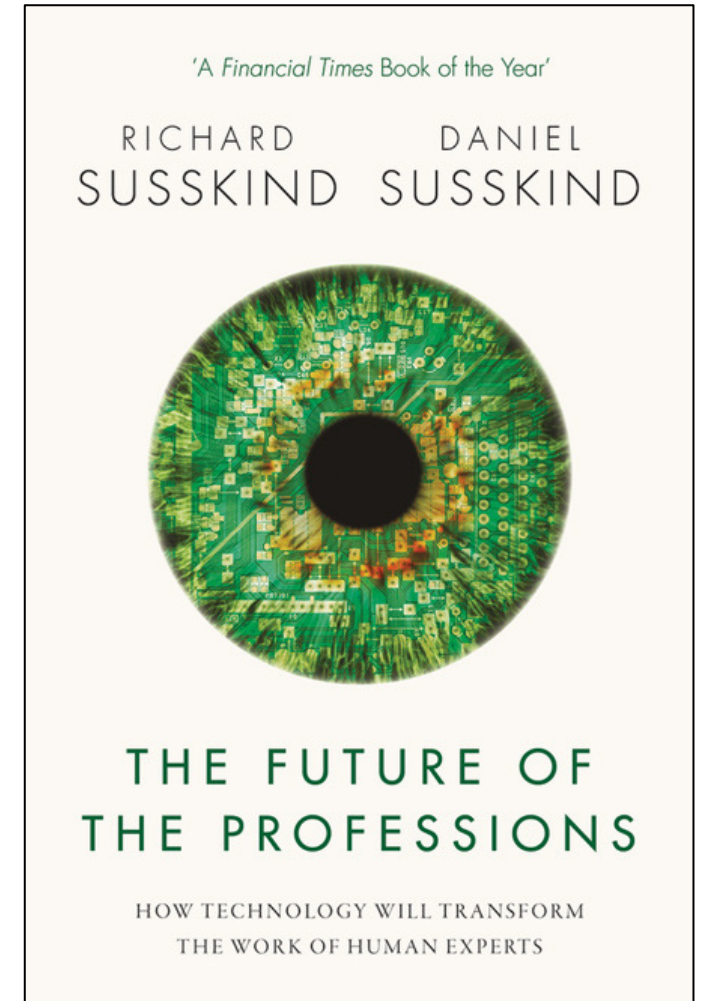
The Future of Higher Education

- Competency based

- Time variable "Open Loop"

- Personalized and Individualized

Competency-Based Veterinary Education

Veterinary education and assessment that is outcomes-based and learner-centered

cbve.org

- De-emphasize time-based training
  - Flexible, individually-oriented curriculum

- Focus on outcomes
  - Start with the end in mind
  - Reverse engineer the curriculum

- Promote learner-centeredness
  - Students take responsibility for their own learning
  - Develop skill in seeking and providing feedback

cbve.org

CBVE

Competency-Based Veterinary Education

Part 1

Competency-Based Veterinary Education:

CBVE framework

1		Clinical Reasoning and Decision-making
2		Individual Animal Care and Management
3		Animal Population Care and Management
4		Public Health
5		Communication
6		Collaboration
7		Professionalism and Professional Identity
8		Financial and Practice Management
9		Scholarship

![AAVMC CBVE Competency-Based Veterinary Education]

Competency-Based Veterinary Education:
Milestones

Define the skill-level for each Competency.
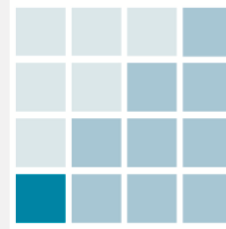
NOVICE:
The minimum expectation for entry to clinical rotations

ADVANCED BEGINNER:
Developing competence
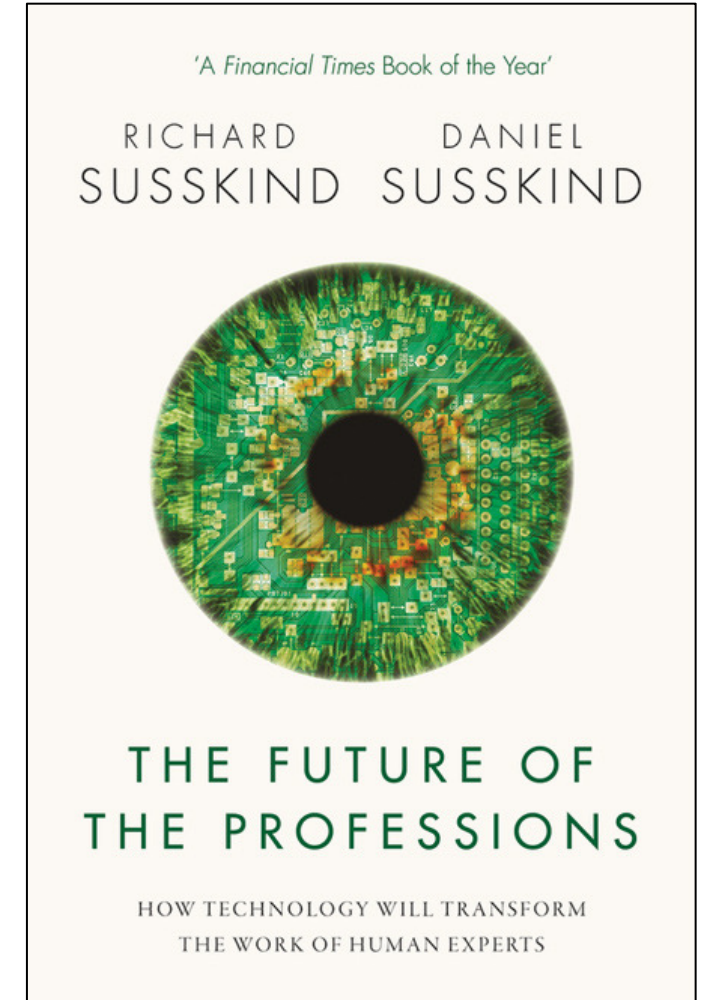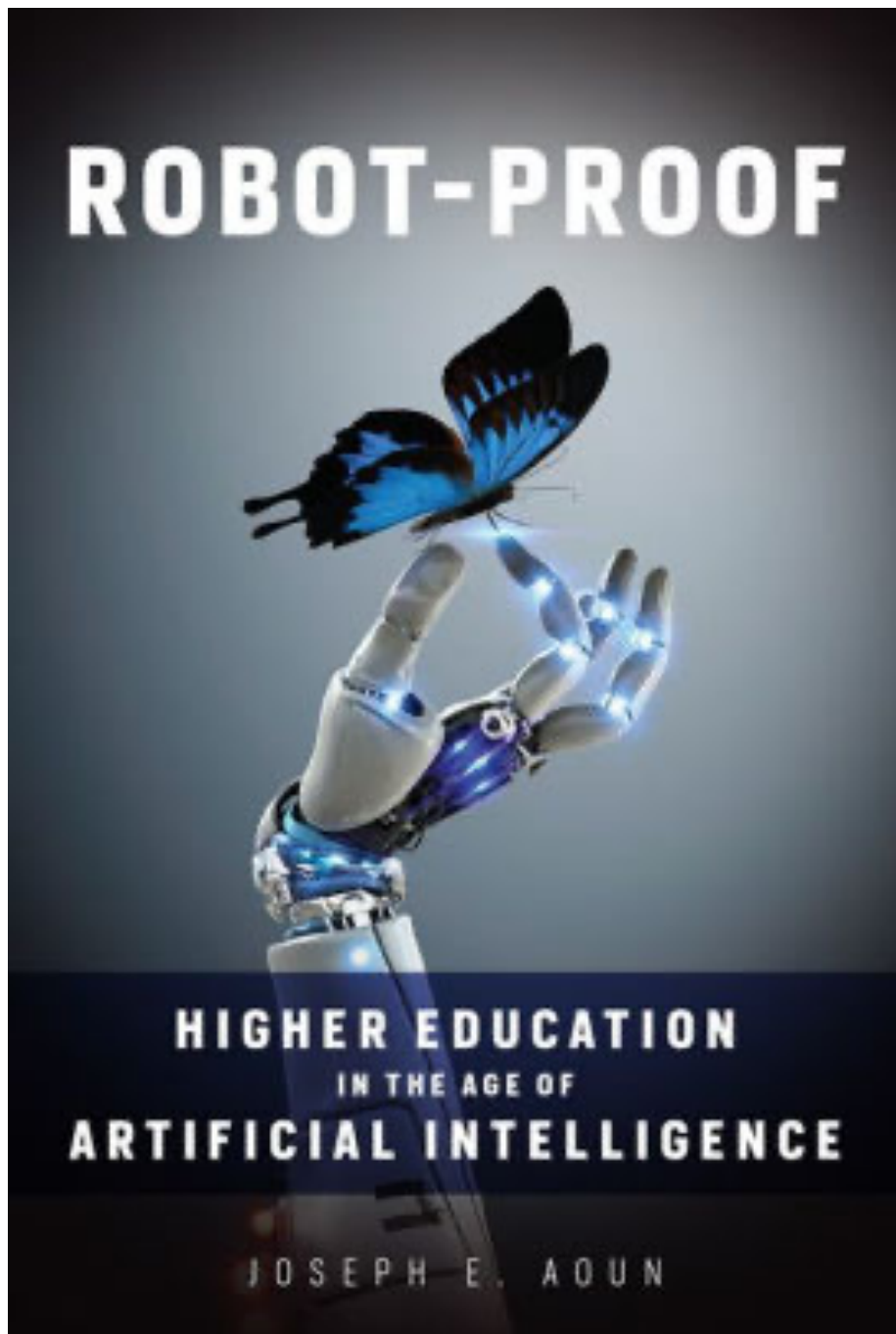
COMPETENT:
Expectation for day-one practice

PROFICIENT:
Aspirational expectation after some time in practice

The Future of the Professions

Emerging Skills and Competencies

- Task analysis, disintermediation, reintermediation
- Relationship with technology and machines
- Mastery of data
- Design thinking
- Systems engineering
- Diversification into new disciplines

'A *Financial Times* Book of the Year'

RICHARD SUSSKIND   DANIEL SUSSKIND

THE FUTURE OF
THE PROFESSIONS

HOW TECHNOLOGY WILL TRANSFORM
THE WORK OF HUMAN EXPERTS

Humanics

New Literacies

- Data literacy
- Technological literacy
- Human literacy

Cognitive Capacities

- Systems thinking
- Entrepreneurship
- Cultural agility
- Critical thinking
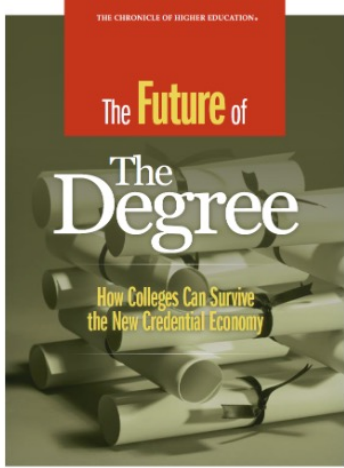
The Future of the Degree:
How Colleges Can Survive the
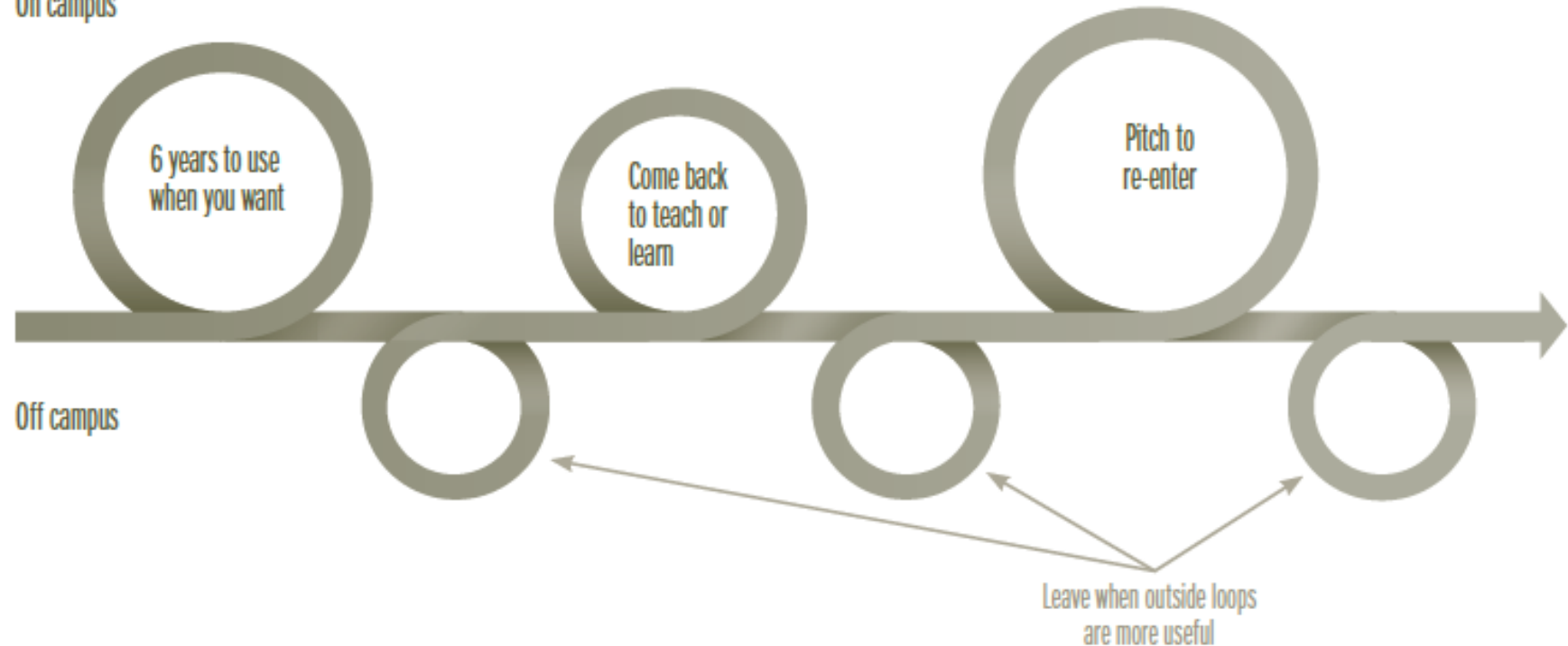New Credential Economy

Jeffrey J. Selingo
Chronicle of Higher Education
August 18, 2017

3.2: HOW THE OPEN LOOP UNIVERSITY WORKS

In 2014, Stanford University's d.school developed a proposal for what it called an "open loop university," which would admit students for six years of study that could be undertaken at any time in life.
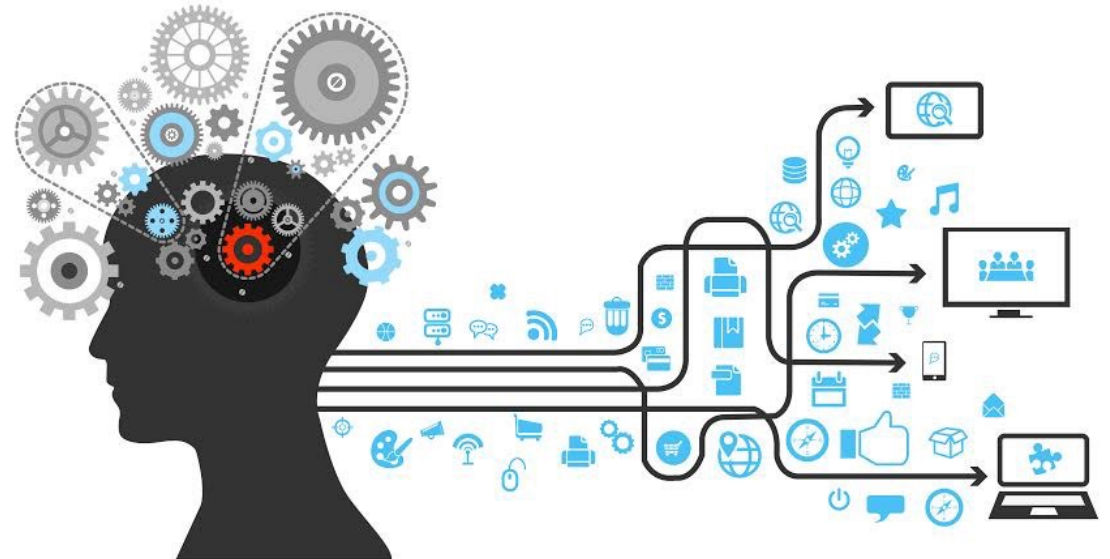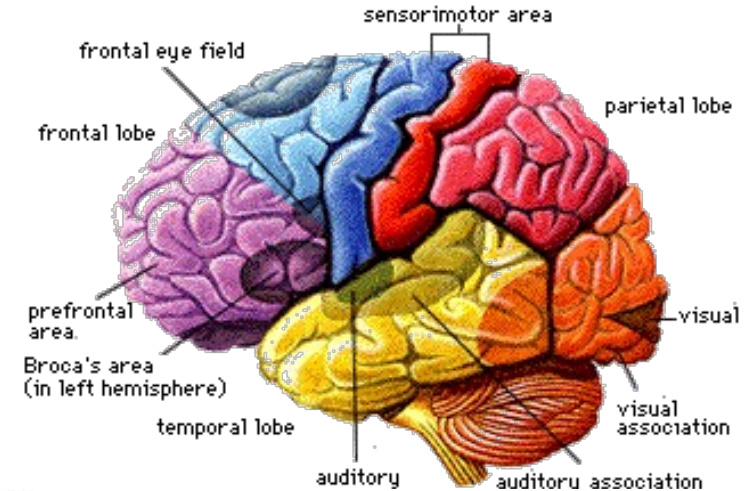
On campus

6 years to use
when you want

Come back
to teach or
learn

Pitch to
re-enter

Off campus

Leave when outside loops
are more useful

The Future of Learning

Uniquely Individual
- Abstract thought
- Active learning
- Higher order cognition

Personalized Learning
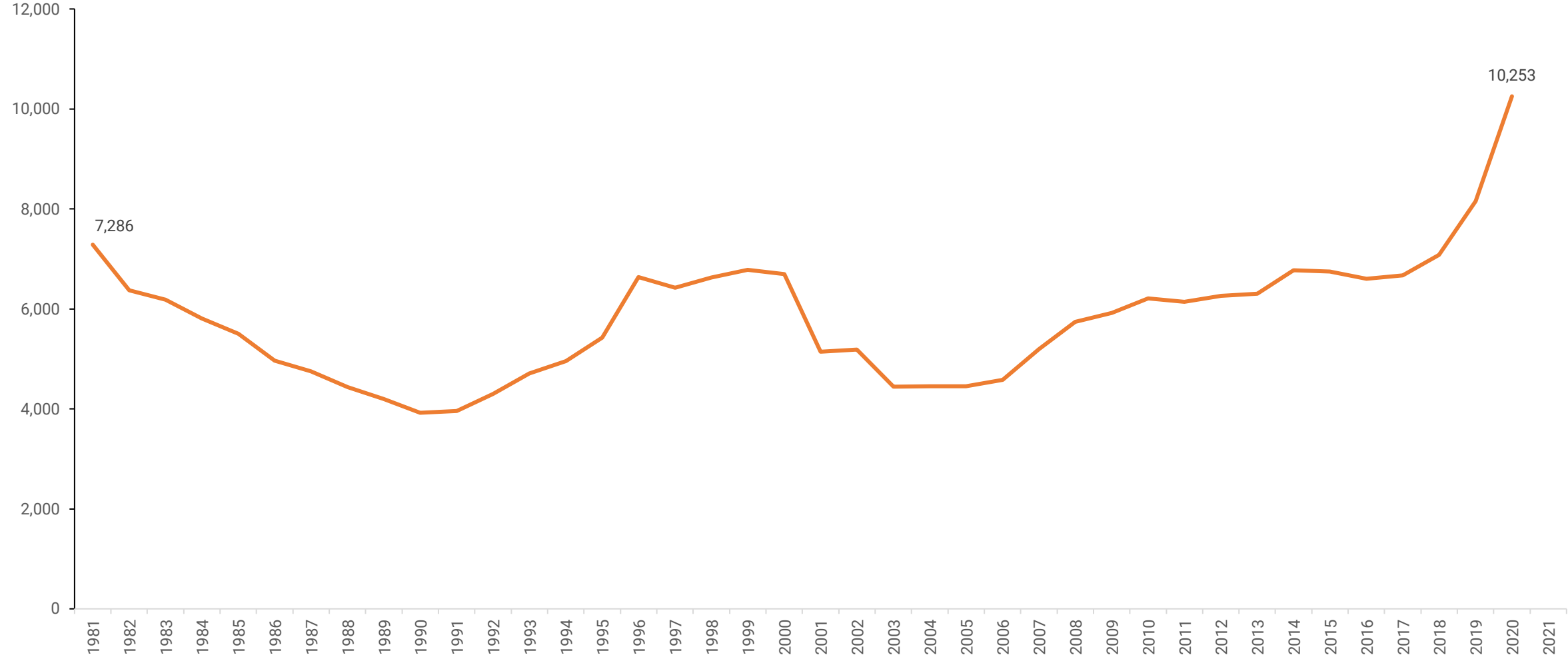- Customized
- Instant feedback
- Self-paced
- Adaptive
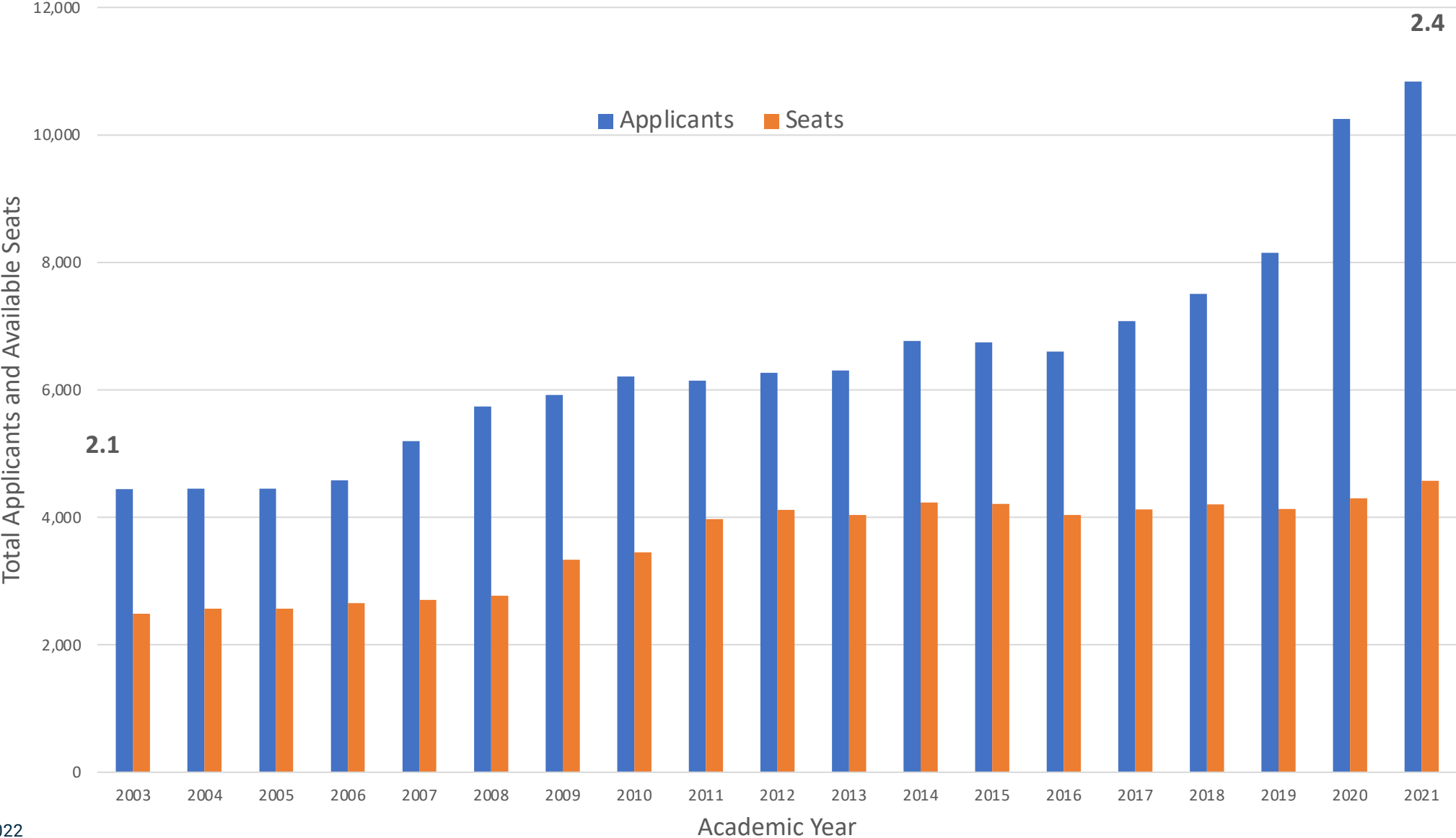
© AAVMC 2022

The Future of Teaching

AAVMC by the numbers

Total Applicants to US Veterinary Colleges
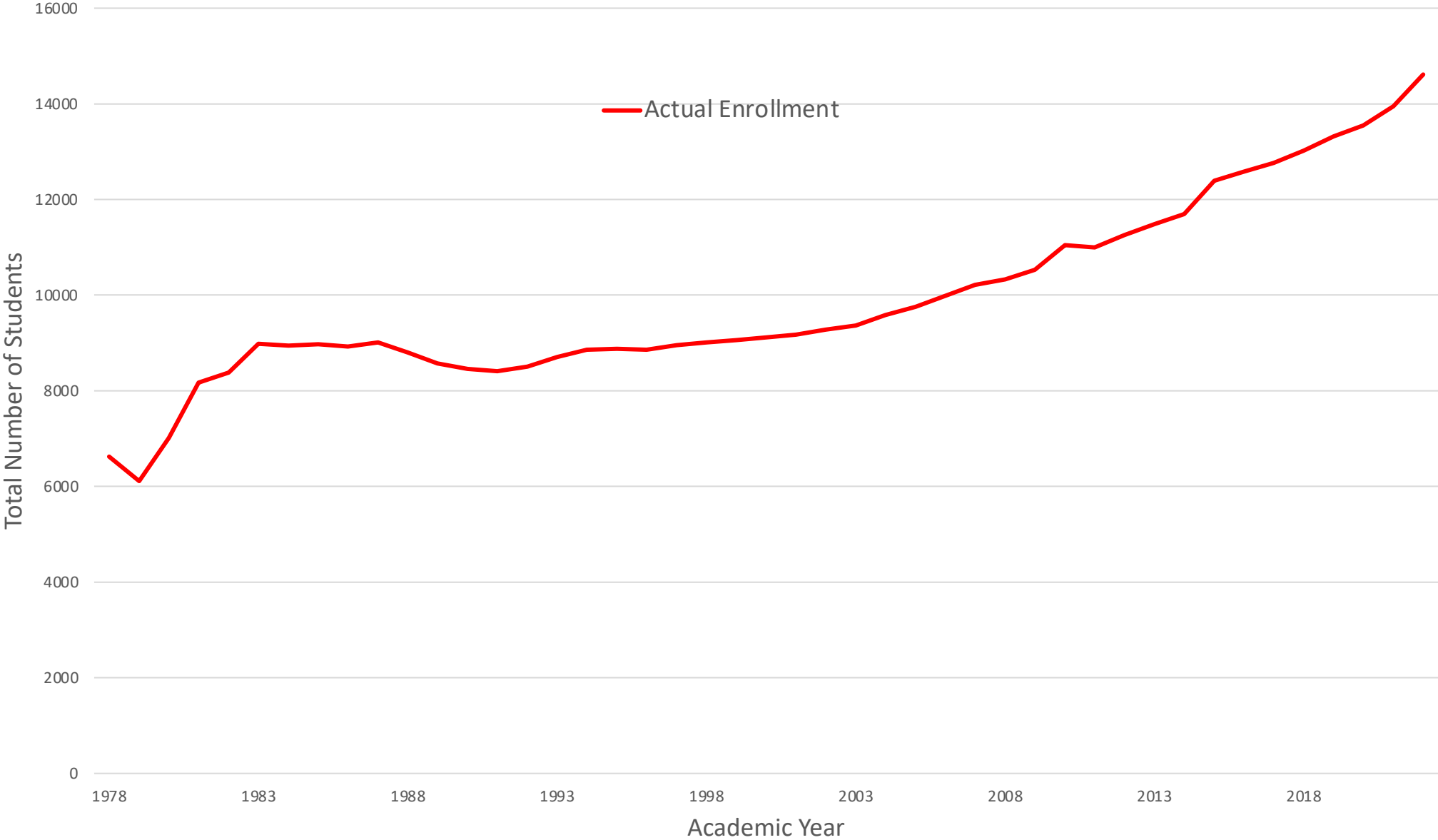AAVMC Internal Data
2021

7,286

10,253

AAVMC

Total Applicants and First Year Available Seats
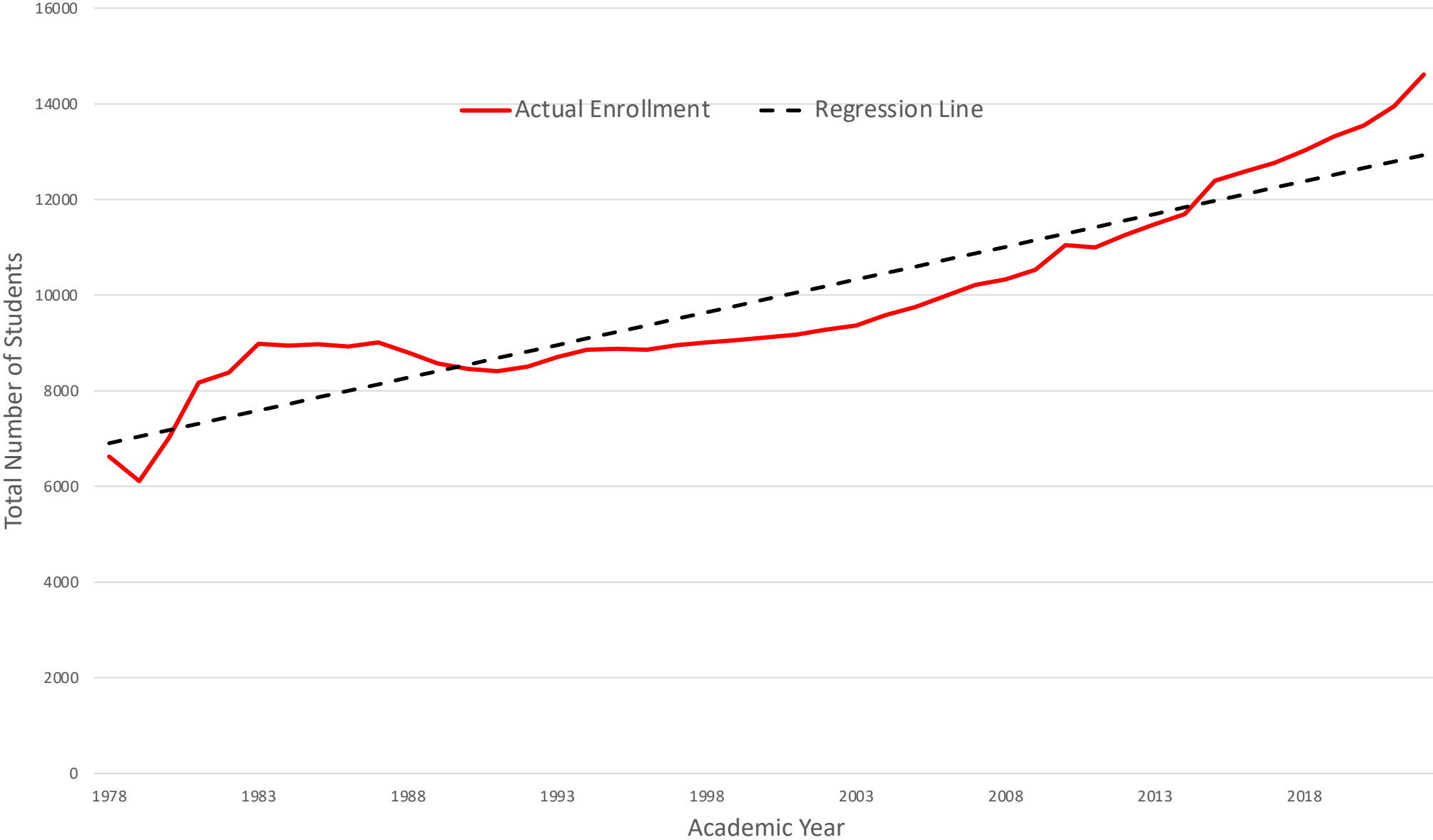## AAVMC Internal Data

© AAVMC 2022

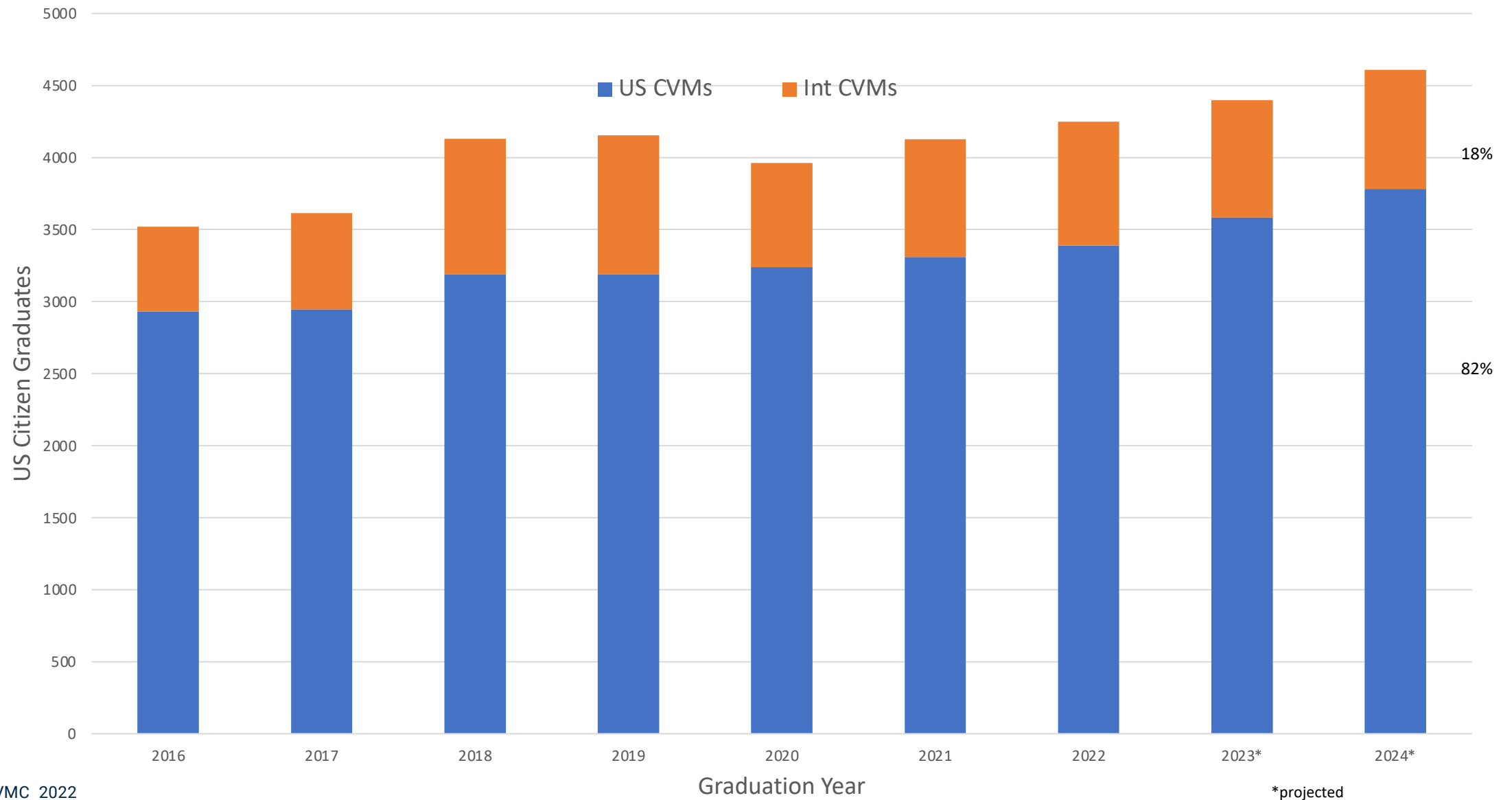# Enrollment at US Colleges of Veterinary Medicine
Internal AAVMC Data Reports

Enrollment at US Colleges of Veterinary Medicine
Internal AAVMC Data Reports

Total US Citizen Graduates
Internal AAVMC Data Reports

US Citizen Graduates

Graduation Year

US CVMs   Int CVMs

18%

82%

© AAVMC 2022

*projected

AAVMC Statement on U.S. Veterinary Workforce

Significant shortages of veterinarians exist across all sectors of professional activity and at all levels of specialization.[i] Although precise numbers are difficult to quantify and specific predictions about future needs are subject to interpretation, the available evidence indicates that these shortages are a result of systemic, long-term trends in pet ownership and demand for veterinary services, along with limited capacity for training veterinary professionals, and are expected to continue unless the veterinary medical profession takes action.

https://www.aavmc.org/wp-content/uploads/2022/07/AAVMC-Statement-on-Workforce-July-2022.pdf

Spectrum of Care

Preparing veterinary students for excellence in general practice: building confidence and competence by focusing on spectrum of care

Roger B. Fingland DVM, MS, MBA

Liesa R. Stone DVM

Emma K. Read DVM, MVSc

Rustin M. Moore DVM, PhD

SPECTRUM OF CARE

A RANGE OF OPTIONS

BASIC	ADVANCED
LOWER COST	HIGHER COST
LESS RESOURCE DEPENDENT	RESOURCE DEPENDENT
ESSENTIAL SKILLS	ADVANCED SKILLS
LOW TECH	STATE-OF-THE-ART

SPECTRUM OF CARE

IS NOT

WORSE	BETTER
UNACCEPTABLE	ACCEPTABLE
UNSUCCESSFUL TREATMENT	SUCCESSFUL TREATMENT
SUBSTANDARD CARE	STANDARD OF CARE
PRODUCT OF SUCCESSFUL EDUCATION	PRODUCT OF PRACTICE EXPERIENCE
LESS CHALLENGING	MORE CHALLENGING

© AAVMC 2022

Spectrum of Care

COMPETENCIES		ILLUSTRATIVE SUBCOMPETENCIES
1.4	Incorporates animal welfare, client expectations, and economic considerations into the diagnostic or treatment plan	a. Considers disease in context of the whole animal and client b. Presents a range of options to the client c. Considers euthanasia as a management option when appropriate

COMPETENT:
Prioritizes a range of feasible management plans, including euthanasia, with consideration of the long-term health and welfare of the animal(s). Recognizes owner limitations and respects owner preferences. Provides clear explanations of the advantages, complications, and prognosis of each option.

PROFICIENT:
Empowers owners to participate in the development of a comprehensive customized management plan for their animal(s), including palliative care. Incorporates available evidence and accurately predicts the expense and value of options.

DOMAIN 1
Clinical Reasoning and Decision-making

The graduate demonstrates critical thinking and problem solving to arrive at evidence-based decisions that consider animal and client needs, available resources, and social context.

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According to the National Association of Veterinary Technicians in America (NAVTA), job satisfaction among veterinary technicians appears to be tied strongly to the application of skills and knowledge that technicians acquire through their education. As with any other professional, when technicians' skills aren't recognized or employed in practice, these valuable team members can become disengaged and dissatisfied.

Are you making the most of your veterinary technicians?

Fortunately, **there are many ways for practices to more fully integrate credentialed technicians on our teams** and better utilize their diverse skillsets.

"**The more credentialed technicians and other non-DVM staff you have supporting each veterinarian, the more likely it is that your hospital will operate efficiently.**"

Team-based Veterinary Healthcare

6.1	Solicits, respects and integrates contributions from others	a. Invites input from others irrespective of role, hierarchy or background b. Acknowledges input and incorporates into ongoing plan of action c. Leverages own role and roles of others to achieve shared goals
6.2	Functions as leader or team member based on experience, skills and context	a. Applies principles of teamwork b. Bases action on collaborative input c. Manages conflict

DOMAIN 6

Collaboration

The graduate collaborates with diverse colleagues, clients and other stakeholders and demonstrates skills as a leader and inter-professional team member to improve outcomes and reduce error.

COMPETENT:
Adapts own roles and responsibilities as needed to meet team goals. Draws on personal experience to be adaptive.

PROFICIENT:
Manages roles and responsibilities of others to meet team goals. Leverages team member experience to adapt to new contexts. Mediates conflict effectively.

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Diversity

*An existential imperative
for veterinary medicine*

Diversity is an essential component of success

- Diversity increases organizational achievement
- Inclusiveness increases cultural competency
- Extensive scientific research validates the benefit of social diversity in group performance
- People "bring more to the table" and "work harder" in diverse group settings
- Everyone gains from inclusive environments

DIVERSITYINC TOP 50

DiversityInc TOP 50 COMPANIES FOR DIVERSITY®

Access the DiversityInc Top 50, Noteworthy and Specialty lists, as well as resources, methodologies, facts & figures and FAQs surrounding the annual competition.

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Importance of Diversity

Cognitive Routine Data Entry	Cognitive Nonroutine Medical Researcher
Manual Routine Assembly Line Worker	Manual Nonroutine Nursing Home Worker

THE DIVERSITY [BONUS]

How Great Teams Pay Off in the Knowledge Economy

SCOTT E. PAGE

Diversity Bonus
- Teams of people
- Different disciplines
- Complex issues

Cognitive Diversity
- Information
- Knowledge
- Representations
- Mental models
- Hueristics

Identity Diversity
- Race, gender, age
- Socioeconomic
- Geographic origin
- Sexual orientation
- Physical capabilities

Gender Distribution at US Colleges of Veterinary Medicine
AAVMC Internal Data Reports
1978-2021
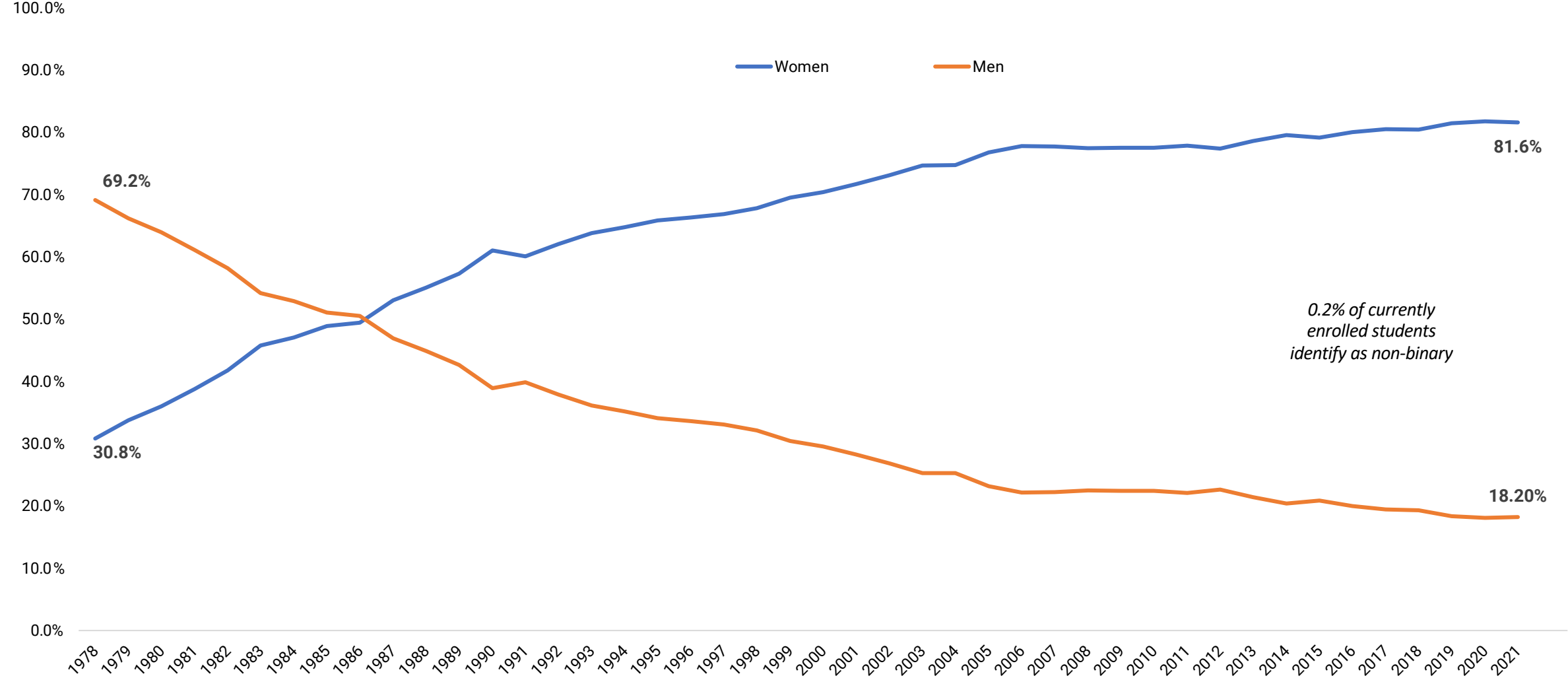
Women — Men

69.2%

30.8%

81.6%

0.2% of currently enrolled students identify as non-binary

18.20%

1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

Class of 2025 Applicants and Enrollees
Shown with Long Term Potential US Applicant Pool
by Gender Identity

■ Non-Binary ■ Male ■ Female

	US Population Ages 0-19	Enrolled in US Colleges	Veterinary Applicant Pool	DVM First Year Enrollees
Female	48.8%	61.5%	87.3%	81.8%
Male	51.2%	38.5%	12.0%	18.1%
Non-Binary			0.7%	0.1%

© AAVMC 2022
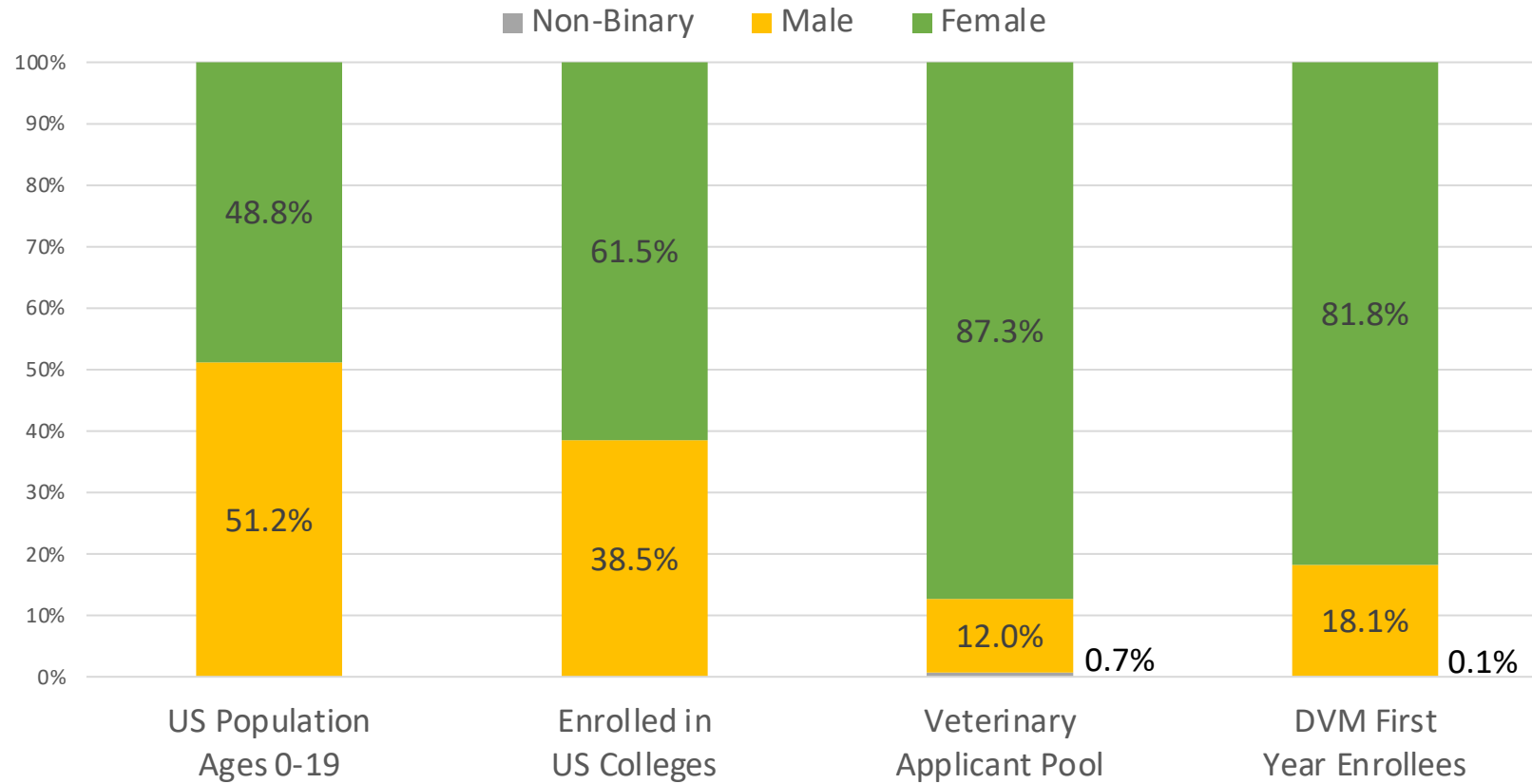
Total Racial Ethnic URVM Representation
at US Colleges of Veterinary Medicine
AAVMC Internal Reports
1978 - 2021
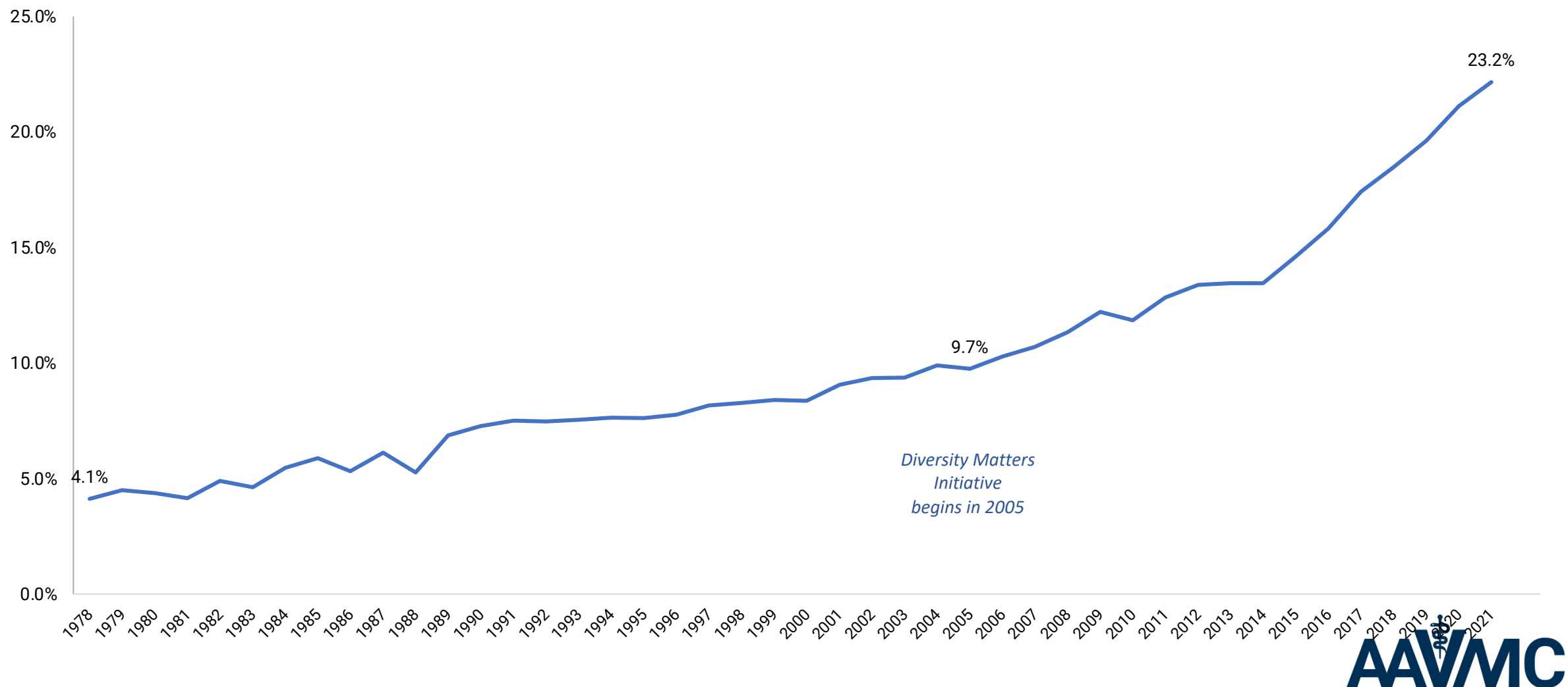
4.1%

9.7%

23.2%

Diversity Matters
Initiative
begins in 2005

25.0%

20.0%

15.0%

10.0%

5.0%

0.0%

1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

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Class of 2025 Applicants and Enrollees
Shown with Long Term Potential US Applicant Pool
by Race/Ethnicity

Legend:
- Foreign Nationals
- Native Hawaiian/Pacific Islander
- American Indian/Native Alaskan
- Two or More Races
- Some Other Race/Unknown
- Asian
- Black
- Hispanic
- White (alone)

US Population Aged 0-19:
- White (alone): 46.90%
- Hispanic: 23.00%
- Black: 13.00%

Enrolled in US Colleges:
- White (alone): 50.60%
- Hispanic: 18.30%
- Black: 13.90%

Veterinary Applicant Pool:
- White (alone): 69.90%
- Hispanic: 10.40%
- Black: 4.90%

DVM First Year Enrollees:
- White (alone): 74.3%
- Hispanic: 9.0%
- Black: 3.7%

What's the point?

The Existential Imperative

Preparing today's students for tomorrow's challenges

- Future challenges and opportunities are unknown and unknowable

- More diverse teams make better decisions

- A more diverse profession can adapt to challenges and take advantage of new opportunities

- Failure to diversify represents an existential threat to the veterinary medical profession

AAVMC