AAP Presidential Address

April 22, 2017

The public good of science for health

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April 22, 2017 was the date of the 132nd annual meeting of the American Association of Physicians (AAP). April 22nd was also the date of the March for Science which was held in 600 cities globally. AAP was a formal sponsor of the March, with 84% of its members endorsing it. Apart from the march, the tri-society AAP-ASCI, and APSA meeting offered its usual evidence of why the March for Science is relevant: that science both represents some of the best of the human condition - of curiosity, knowledge, and exploration of the meaning of being human - and is a basis for securing a better future.

The premise that science will serve better health futures goes back to the founding of the AAP in 1885. Established "for the advancement of scientific and practical medicine", it was formed and led by the – then-young Turks, who were forceful leaders in bringing science to medicine in the U.S. Their expectation was that scientifically-based medicine would transform the physician's ability to improve the health of patients. We now can look back on the results: more than 130 years of advances in science have been critical to the U.S. and to the world, creating dramatic improvements in health, wellbeing, life expectancy and prosperity. One summary metric demonstrates an increase in life expectancy by over 30 years in the last 100 years (1), largely due to the scientific contributions of public health and medicine; improved education; and poverty alleviation. Further, Robert Solow's Nobel Prize-winning attribution is that over half of all economic growth in the U.S. since WWII is due to technological progress, and our underlying investments in education, basic science, research and development, and infrastructure (2). At the same time, improved health status of the U.S., and of all nations, is fundamental to our productivity as well as our wellbeing and longevity.

I have had the opportunity to review the archives of the AAP and find that it offers a history of the roots and the trajectory of these achievements, in terms of the U.S. origins of medical and public health science and then the evolution of medical science in particular. I would like to reflect on this trajectory and the accomplishments, and suggest how I think this offers a lens to both understand the impact of science on health; the impact of health on wellbeing and our future; and suggest a redefined status for science for health as a public good.

AAP was organized in 1885 to be a society of "American physicians and pathologists" – initially limited to 100 members - who would meet annually to discuss subjects of "general interest for the advancement of scientific and practical medicine". (Table 1)

The first Council of AAP included 7 physicians, from the east coast, Chicago and Montreal, including several who were at the forefront of the move to make science the basis for advancing medicine. The members are listed in Table 1. The latter two in the Table, Drs. William Osler and William Henry Welch, are preeminent figures in medicine and science.

Figure 1 shows a photo of William Osler, who became AAP President in 1895, while he was writing the "Principles and Practice of Medicine". Osler was the creator of the medical residency, bedside rounds and clinical clerkships, and was the author of "Aequanimitas". He was one of the "fab four" who started The Johns Hopkins School of Medicine, the first U.S. medical school committed to science as the foundation to medicine. Figure 2 shows a photo of the AAP President's Gavel. It is made from the wood from Dr. Osler's birthplace home in Bond Head, Canada.

The other member from the first AAP council meeting who I would like to particularly honor is William Henry Welch (Figure 3), the impresario of U.S. scientific medicine who started the Johns Hopkins School of Medicine, recruited all of its initial faculty, and served as Founding Dean from 1893-98 – with the goal of creating the first scientifically-based school of medicine in the U.S. Welch was President of AAP in 1901. He subsequently served as Founding Dean of the first school of public health, at Johns Hopkins, from 1916-26. In fact, Welch proposed that a school of public health be developed at the same time as the school of medicine, but that ultimately happened sequentially. Welch also served over his career as the Founding editor of the *Journal of Experimental Medicine*, and President or Chairman of 19 major scientific organizations, including AMA, AAAS, NAS, and the National Research Council, as well as AAP.

The founders' vision for AAP was to foster discourse and advances in understanding through an annual meeting that would span the full breadth of physician-led science, and to generate exchange *across* disciplines and *between* science and practice. There were to be original communications, and demonstrations of gross and microscopic preparations and of apparati and instruments.   After the first meetings they immediately decided to "issue a volume of transactions each year" - since discontinued - and also decided that social events that would foster a community of medical scientists were important, and they created the annual dinner AAP still holds.

The first two AAP meetings give us insight into where medical science was at the onset of AAP. The first meeting had a debate: "Does the present state of knowledge justify a clinical and pathological correlation of rheumatism, gout, diabetes and chronic Bright's disease? "

Other presentations included:

- "Certain elements found in the blood of malarial fever"
- "Demonstration of bacterial cultures from a case of mycotic endocarditis in man, and of specimens showing the experimental production of the disease in rabbits" - the first mention of animal models.

It is amazing that these scientific discoveries were occurring less than 40 years after Virchow first set out to create a cellular theory of human biology.

In 1887, the second AAP meeting had 2 debates, one of clinical interest ("antipyretic therapy and its use in the treatment of typhoid fever") and one of pathological interest ("embolic infarctions"), plus a presentation of "cases of sewer gas poisoning".

The meetings typically spanned pathophysiologic investigations, bacteriology, and evidence on the environmental causes of disease. After only two meetings, in October 1887, they had their first debate of the Council about how narrow or broad the society should be. Council voted out the following motion:

> *"Dr. Miles should be informed of the large number of papers on cardiac subjects, and that it be suggested to him that it would be advisable to choose some other subject for discussion".*

The following year, 1888, in response to this request, the meeting ranged in topics from "geographical distribution of typhoid in the U.S.", to "management of typhoid convalescence", to the "demonstration by Dr. Welch of a series of microscopical specimens of the thyroid gland", to "photographs of bacteria", to one cardiac topic: "disturbances of heart rhythm with reference to their causation and their value in diagnosis".

This discussion continues to this day: how to learn from the *most* cutting-edge of clinically relevant sciences in ways that honor key advances in science and also supports cross-fertilization and synergies across fields. The 2017 meeting sought to tackle this 130-year old discussion in a new way: the tri-society planning committee selected 3 themes (see Table 2) and invited speakers to represent the spectrum of physician-led science within each theme. Our goal here is to represent the phenomenal breadth of our members' science, but also to do more of what the founders were intending: both the cross-fertilization across fields, and linking the discrete parts of the full cycle of science to foster appreciation of the interconnectivity between sciences and propel translation to impact.

Figure 4 presents a conceptual expression of our goals to represent the full cycle of translation, which entails discovery at every level of the progression of science. Physician-led science for health begins with 1) the challenge of the clinical problem, 2) develops evidence as to its import and prevalence, and 3) establishes standardized characterization of the clinical problem and clinical and population-based evidence as to etiology and consequences. From this base, discovery involves hypothesis development, elucidation on question and evaluation (4-5) across populations and the laboratory (6). Ultimately, interventions can be developed from each stage to improve the clinical problem being addressed.

The archives of the scientific advances reported and discussed by AAP members since its inception show many of the same topics we considered at this 2017 meeting, and illuminate the dramatic progression of science over more than 130 years. For instance, Table 3 displays some examples of original communications on brain science presented at AAP meetings in its initial years. Table 4 shows some of the initial presentations on approaches to measuring and displaying clinical characteristics, circa 1900. Table 5 displays a range of examples of talks on infectious disease at AAP meetings from 1885-1914, while Table 6 displays examples of the early work on vaccines.

Susser and Stein, in 2009, offered a broad summary of the generational progression of science since Welch, conceived as eras and conceptually displayed in graphical form in Figure 5. (3) These eras very much align with AAPs trajectory of science at its meetings. Further, the trajectory of health improvement in the US in the last 100 years resulted from these scientific advances along with improvements in living conditions, education and poverty. The dramatic improvements in our population's health is something that we sometimes take for granted, even while we constantly push forward to make the next advance that is needed. Just to tip our hat to those advances, we can compare measures of health status in 1900 to those in 2000:

- *In 1900, the top 3 causes of death were infectious diseases; by the mid-20th century it was chronic diseases. (4)*
- *From 1920 to 1940, the U.S. saw dramatic declines in tuberculosis and typhoid fever, and in 1949 small pox disappeared from US; polio vaccines, implemented shortly after, led to eradication of polio in the US. (5, 6)*

- *Due to vaccines, it is estimated that 103 million cases of smallpox, polio, measles, rubella, mumps, Hepatitis A, and diphtheria have been prevented <u>in the US</u> since 1924 – including 24 million in the last decade (7).*
- *The advent of the antibiotic era in the mid-20th century was a component of the tremendous advances in pharmaceutical therapies. By 1950, more than half the drugs in common medical use had been unknown 10 years before. (8)*
- *At the same time, population-based and laboratory evidence showed us that a substantial proportion of major chronic diseases are preventable. This includes 50% of cardiovascular disease (CVD) and 30-50% of cancers (9). Prevention is accomplished through lifestyle changes or early detection and treatment of risk factors. By 2000, Interventions have resulted in a decline in age-adjusted CVD mortality rates to one-third of their 1960's baseline; half of this decline was due to effective prevention and half from treatment (10).*
- *U.S. life expectancy rose from 47 to 68 over 50 years, and to 79 years over 100 years (11).*

Reviewing data like these, and many more, it is clear that science has transformed the health of our nation – the dream of 130+ years ago has borne fruit. This evidence that science can really improve health provides a basis for changing the conversation in the public sphere to one of understanding both health *and* the science that enables it as "public goods".

To explore this, let's start with the arguments used by economists through the concept of "public bads" which are applied to global health challenges. "Public bads" is a formal economic term for circumstances that are seriously negative for people and society and that are "non-excludable", meaning that everyone is at risk. (12) Generally, pandemics, HIV and other contagious diseases or drug-resistant microbial strains are readily recognized as "public bads", along with tobacco, poor food quality, and food and water insecurity.

We also now know that societies that are ill are less productive. If we look at diseases endemic outside the U.S., such as malaria, the "public bad" impact is clear: from 1965-1990 more than one-third of the countries with intensive malaria had negative economic growth, compared to an average rate of economic growth of 2.3% in countries without malaria (13). Our recognition of ill health as a "public bad" has recently extended – as our evidence as to modifiability has grown - to other global exposures that affect health and that require collective action to protect people, including curtailing tobacco smoking and the serious impacts on health of both air pollution and global warming. Thus far, these discussions have occurred in a global context. And yet, the U.S. has many of its own "public bads" in terms of ill health and its causes. Among many in the news in the last year is the recognition of serious causes of ill health from water pollution from industrial run-off or corroded pipes. (Notably, the relation of drinking water to disease was first introduced in AAP in 1892 in a presentation on the "bacteriological study of drinking water".)

The fact that this most recent evidence has not led to renewed commitment to strengthening environmental science and action to protect against these "public bads" suggests that our public and decision makers don't know enough about the modifiability of health or the highly cost-effective benefits of prevention. Or, perhaps they do not see a public responsibility to resolve these "public bads".

It is the latter that takes me from the concept of "public bads" to its companion concept, "public goods". Most goods are <u>private</u> – in the sense that consumption can be withheld until a payment is made for them, and once consumed they cannot be consumed again. In contrast, we implicitly understand that health is a public good, and that health meets the economists' definition of "public goods" as goods that are useful for the public generally, exist in the public domain, and where the benefit is shared at the societal level. Further, consumption by one individual does not reduce the amount available to be consumed by another individual, and individuals cannot be effectively excluded from use (Table 7). Examples generally cited as public goods are national parks, public transport, and clean air. The public good nature of health can now be advanced because of the evidence that health is modifiable; that science gives us the knowledge of how to improve health forms the argument for societal investment in science for health. This has rarely, if at all, been articulated in this context. We can do this now because of a century of compelling evidence that health and longevity can be improved, that improvements are based on scientific knowledge, and, together, they propel the wellbeing of society.

Based on this rationale, I think that we would do well to now apply the concept of global public goods for global health to our own U.S.-focused articulation of <u>why science for health</u> matters, as well as to health itself.

There are <u>two parts</u> to health as a public good. First, *scientific knowledge* itself is a public good. The cost of sharing knowledge with everyone is zero or relatively modest, and <u>your</u> knowing something does not limit my ability to know it. Plus, knowledge has important public properties of decreasing disparities and strengthening society. Of course, knowledge also has significant private properties, since it is produced by individual researchers and teams, and can be withheld and thus made “excludable”; further, researchers want to be adequately rewarded for their efforts and to have adequate investment for innovations in R&D products. For these reasons, it is thought that policies should foster both private and public goods for the health economy (14).

Second, the *health* that results from scientific knowledge is a public good. As I cited before, ”public bads” undermine a society’s productivity and wellbeing. Because communicable diseases are not exclusive to one person or group vs. another, and if you get it that doesn’t mean I won’t, communicable disease control is most readily recognized as a public good: once achieved, it benefits all people, both poor and rich, and future as well as present generations. Additionally, one person’s “consumption” – let’s say preventive measures or treatment – is often necessary for another to benefit in the case of infectious diseases. We now know this is also true in the case of social contagion, such as for obesity (15), or even for our collective health care costs (16). To achieve prevention or treatment requires collective investment in the knowledge and then investment in the provision of the solutions. An outstanding example of this presented at this 2017 tri-society meeting are the new approaches to pandemic preparedness (17).

One other critical aspect of public goods is that the production and provision of these goods is often not remunerated sufficiently for the market to find it worthwhile to invest. Often, there are no natural commercial incentives to produce these goods in a market economy. Therefore, under-provision is likely for public goods without any strong special interest support (18). This is the basis for what Adam Smith argued in 1802: *He recognized the existence of certain goods which he thought “may be in the highest degree advantageous to a great society, but are, however, of such a nature that the profits could never repay the expense to an individual or small number of individuals, and which it therefore cannot be expected that any individual or small number of individuals should erect”* (19).

But, as was articulated at the 2017 tri-society meeting, public and private sectors need to enact this together. We now know that investing in health for all – as a public good – has a high return on investment (ROI) for society. The prevention and containment of infectious or communicable diseases are classic cases of public goods and high returns. For example, it is estimated that devoting an additional $100 million to HIV vaccine research and development is valued to generate returns 6-fold as high (20). The ROI is at least as high from decreasing air pollution (21). Another recent example is the

Human Genome Project, conducted from 1988-2003 and costing .005% of US GDP spread out over 15 years, or $3.6 billion. Even before we see the health effects realized to the extent we anticipate (22, 23), it is estimated that the Genome Project had a return on investment over 14,000 percent in terms of economic output per federal dollar invested since 1988, and 310,000 jobs. (24) Beyond this, U.S. health science investment is a global public good for our interdependent world, helping people everywhere benefit from, as Speth said, "the accumulated stock of global knowledge" (25).

Collective action for the creation of public goods – by both the public and private sectors together – underpins each of these.

The health of our population would greatly benefit from our societyal investment in both improving health itself and in the <u>science</u> for health, recognizing that both are <u>both public goods</u>: for the knowledge production by science, for the value for individuals and the productivity of society, and for the high return on investment for health. Further, the nonexcludability and nonrivalrousness of health for all of us (if you get healthy it doesn't deprive me of the opportunity for health) which exemplifies a public good. Social policy that sees health and its foundational science as public goods is essential to ensure the benefits are available to all and to create the most health for the resources required.

If science for health and health itself are understood to be public goods, then it is to our collective benefit to secure these. Further, pure public goods that are inseparable and inclusive can only be provided by public means. Adam Smith said it best here as well: *"Increasingly, we will need to be explicit about how governments and markets should work together to provide the range of goods fundamental to people's well-beings".* [26] The evidence is that we need to include health investments in that public good expectation.

Implicit in this is the social compact involved. One dimension of that social compact is with us, the scientists themselves: that scientific results that were created as public goods are made fully available to the public – nonexcludable and nonrivalrous.

The March for Science that was held today, April 22nd 2017, advocates that the value and need for ongoing investment in science – and its basis for sound policy needs to be valued by our political leadership, and by the public itself. In past decades, commitment to public goods is thought to have receded, in part from higher valuation of market forces and patent rights; this has contributed to our lack of preparedness or effective response to many of the health crises we have seen domestically and globally (Kaul and Faust). Overall, as has been said by Sean Pool as of 2011, "[…] the US has not kept up.

Our national investments in research and development as a percentage of discretionary public spending has fallen from a 17% high (1962) to 9% today, with the biggest decline in civilian research and development" (27).

Actually, all the evidence indicates that we need more science for health at this critical time. We are on the cusp of many breakthroughs in longstanding as well as emerging areas. At the same time, many new health needs and opportunities are emerging – starting with the evidence that the health status of the US has fallen substantially relative to peer nations in the last two decades, and now stands at the bottom of our peer nations, according to a report of the NAM/NRC (28, 29).

The themes of today's tri-society meeting include some of the urgent and emerging issues for our health. These needs extend much further, from the health impacts of poisoned water in the U.S. to the health and disease challenges of older age in an aging society to antimicrobial resistance, and many more. Further, new issues stand on longstanding problems: the U.S. stroke belt was originally in the northeast, then moved to the southeast as northeast became healthier.Since 1940, the highest stroke mortality rates have been, and remain, in southeast US (30). This same area is also a hotspot in the US opioid addiction belt, for obesity, and a region of high cancer mortality hotspots.

One could argue that leadership by members of the AAP and by the organization itself may be more important than ever and that the investment in science for solutions is critical. This takes us back to the March for Science today across the U.S., and the AAP membership's stance – by 84% of members – that the organization should formally endorse the march. Some say that AAP is a "pure science" organization and should not offer opinions on anything outside the conduct of the science itself, and others say that this is not something AAP has done. Interestingly, at least to me, I reviewed the history of the AAP to ask myself this question. I found that, since its inception, the AAP has spoken out, albeit intermittently, as an organization, on issues of science, policy and practice for the public good in areas of its mission: that objective science and evidence are essential foundations for improving health and health care.

In his 1978 AAP Presidential address, Kurt Isselbacher said that *"I look forward to the time when the Association includes in its responsibilities a new role – involvement in the shaping of science and health policy, for there can be little doubt that what happens in the powerful corridors of Congress is as important to our future as what happens in our lecture halls and our laboratories."* The AAP's endorsement of the March for Science is in line with his wish, and with the evidence.

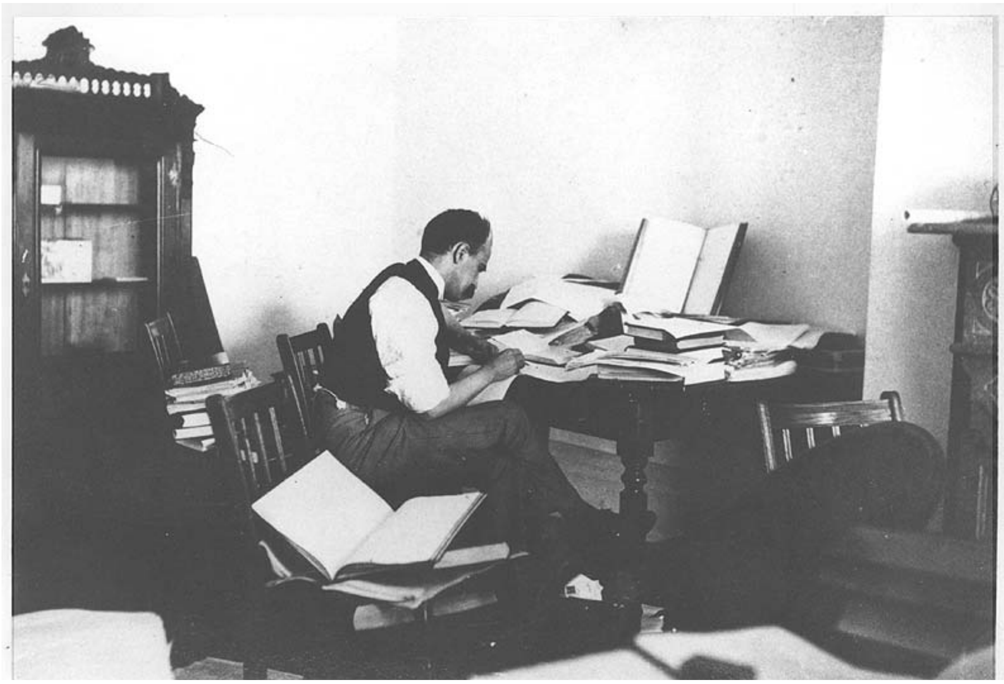
In a fitting conclusion to this years, and this day, I am pleased to announce that the 2016-17 Coiuoncil has just completed substantial work leading to a 21st Century Statement of the mission of AAP (Table 8.) Perhaps the evidence of a public goods framework of science for health, united with the modern understanding of public and private collective commitments required to meet our responsibilities for health, could now be translated into a 21st century social compact —addressing the essential and sustained basis for societal investment in science and in health. The AAP's sponsorship of the March for Science is consistent with this vision.

References

1. National Institute on Aging and World Health Organization. *Global health and aging* Publication 11-7737. Bethesda, MD, USA: National Institute on Aging; 2011.
2. Solow RM. Technical progress, capital formation, and economic growth. *The American Economic Review*. 1962;52(2):76-86.
3. Susser M, Stein Z. *Eras in Epidemiology: The Evolution of Ideas.* New York, NY, USA: Oxford University Press; 2009.
4. Centers for Disease Control and Surveillance. Achievements in Public Health, 1900-1999: Control of Infectious Diseases. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm4829a1.htm. Accessed June 2, 2017.
5. Cutler DM, Miller G. The role of public health improvements in health advances: the twentieth-century United States. *Demography.* 2005;42(1):1–22.
6. Pallansch MA., Sandhu HS. The eradication of polio—progress and challenges. *NEJM.* 2006;355(24):2508-2511.
7. Van Panhuis WG, Grefenstette J, Jung SY, et al. Contagious Diseases in the United States from 1888 to the Present. *NEJM*. 2013;369(22):2152-2158. doi:10.1056/NEJMms1215400.z
8. Centers for Disease Control and Surveillance. Achievements in Public Health, 1900-1999: Control of Infectious Diseases. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm4829a1.htm. Accessed June 2, 2017.
9. Anand P, Kunnumakara AB, Sundaram C, et al. Cancer is a Preventable Disease that Requires Major Lifestyle Changes. *Pharmaceutical Research*. 2008;25(9):2097-2116. doi:10.1007/s11095-008-9661-9.
10. Feigin VL, Norrving B, Mensah GA. Global burden of stroke. *Circ Res.* 2017;120(3):439-448. doi.org/10.1161/CIRCRESAHA.116.308413
11. National Institute on Aging and World Health Organization. *Global health and aging* Publication 11-7737. Bethesda, MD, USA: National Institute on Aging; 2011.
12. Kindleberger CP. International public good without international government. *American Economic Review*. 1986;76(1): 1-13.
13. Kaul I, Faust M. Global public goods and health: taking the agenda forward. *Bull World Health Organ*. 2001;79(9):869-874.
14. Kaul I, Faust M. Global public goods and health: taking the agenda forward. *Bull World Health Organ*. 2001;79(9):869-874.
15. Christakis NA, Fowler JH. The spread of obesity in a large social network over 32 year*. N Engl J Med.* 2007;357(4):370–9.
16. New England Healthcare Institute. A Matter of Urgency: Reducing Emergency Department Overuse website. http://www.nehi.net/writable/publication_files/file/nehi_ed_overuse_issue_brief_032610finaledits.pdf. March 2010. Accessed June 13, 2017.
17. Jamison DT, et al. Global health 2035: a world converging within a generation. *Lancet.*2013;382(9908):1898–1955.
18. Varian, Hal R. *Microeconomic Analysis*. New York, NY, USA: Norton; 1992.
19. Smith A. *An Inquiry into the Nature and Causes of the Wealth of Nations.* New York, NY, USA: Modern Library; 2000.

20. Jamison DT, et al. Global health 2035: a world converging within a generation. *Lancet.*2013;382(9908): 1898 – 1955.
21. Hutton G, et al. Evaluation of the costs and benefits of interventions to reduce indoor air pollution. *Energy for Sustainable Development*. 2007;11(4):34-43.
22. Pool S. Investing in innovation pays off. Science Progress website. https://scienceprogress.org/2011/05/investing-in-innovation-pays-off/. May 18, 2011. Accessed June 6, 2017.
23. Gitlin JM. Calculating the economic impact of the human genome project. National Human Genome Research Institute website. https://www.genome.gov/27544383/calculating-the-economic-impact-of-the-human-genome-project/. Updated June 12, 2013. Accessed June 6, 2017.
24. Trip S Grueber M. *Economic Impact of the Human Genome Project*. Battelle Memorial Institute Technology Partner Practice; 2011. https://www.genome.gov/27544383/calculating-the-economic-impact-of-the-human-genome-project/. Accessed June 6, 2017.
25. Kaul I, Grunberg I, Stern M, eds. *Global public goods: international cooperation in the 21st century*. New York, NY, USA: Oxford University Press; 1999
26. Heilbroner, RL. *The Worldly Philosophers*. New York, NY, USA: Touchstone; 1999.
27. Pool S Erickson J. The high return on investment for publicly funded research. Center for American Progress website. https://www.americanprogress.org/issues/economy/reports/2012/12/10/47481/the-high-return-on-investment-for-publicly-funded-research/. December 10, 2012. Accessed June 6, 2017.
28. Institute of Medicine and National Research Council. *U.S. Health in International Perspective: Shorter Lives, Poorer Health*. Washington, DC, USA: The National Academies Press; 2013. doi:/10.17226/13497.
29. Xu J Murphy SL, et al. Mortality in the United States, 2015. *NCHS Data Brief*. 2016;267:1–8.
30. Lanska DJ Lewis HK. The geography of stroke mortality in the United States and the concept of a stroke belt. *Stroke*. 1995;26:1145-1149. doi:10.1161/01.STR.26.7.1145

Figure 1

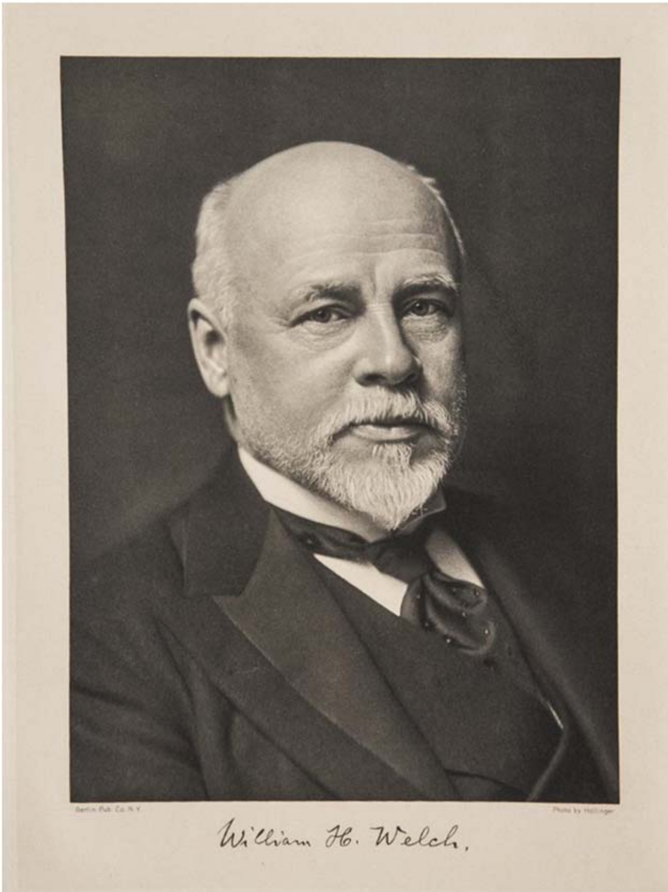


Osler at work on his textbook.

Figure 2

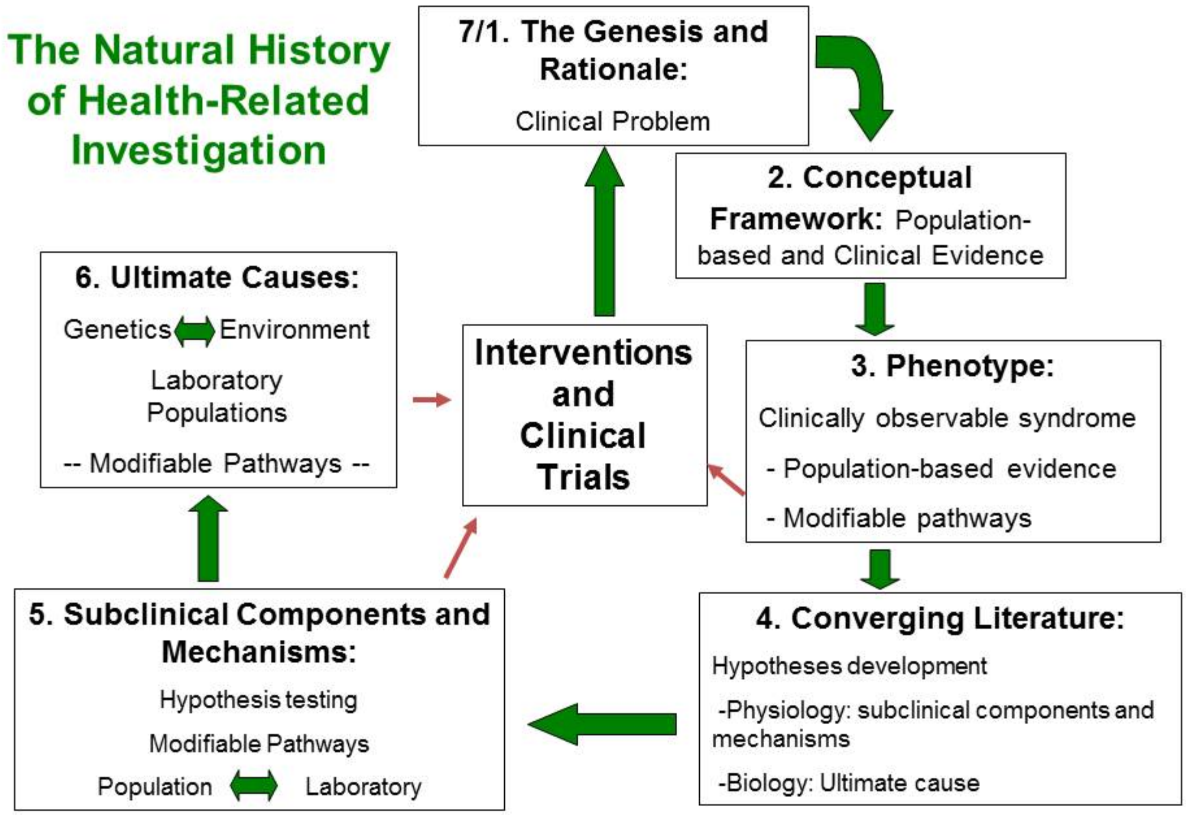
Gavel

Figure 3



U.S. National Library of Medicine

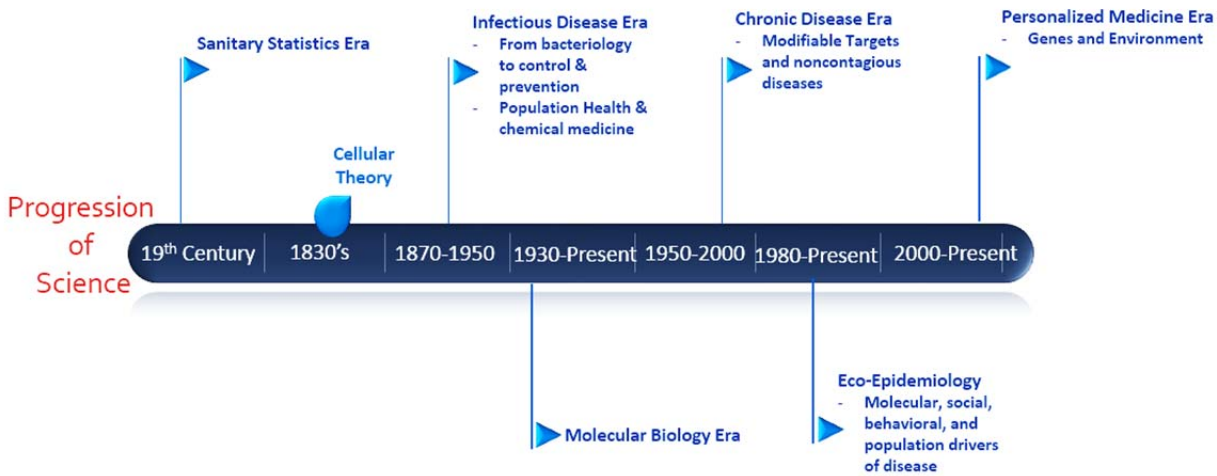
Figure 4



Ultimately, interventions can be developed at each level, to improve the clinical problem being addressed.

Figure 5

Progression of US Science for Medicine and Public Health



Conceptually displayed summary of the generational progression of science since Welch. (3)

Table 1

Association of American Physicians: First Council, 1885

- President: S. Weir Mitchell (Philadelphia)
- First Vice President: Francis Minot (Boston); 2nd Vice President: J Palmer Howard (Montreal)
- Council members:
  - Samuel C. Busey (DC)
  - William Draper (NY)
  - Robert Edes (Boston)
  - H.M. Lyman (Chicago)
  - Wm Osler (Philadelphia)
  - Frederick Shattuck (Boston)
  - W. H. Welch (Balto)

Table 2

2017 Trisociety Meeting Themes

- Healthy brain, healthy living
  - Promotion of cognitive resilience
  - White House BRAIN initiative
  - Biology of Memory and Age-related Memory Loss
  - Drugs, neurotransmitters and the brain
- Visualizing medicine
  - Translational pathways to impact
  - Visualizing GPCR
  - Areas requiring urgent responses
  - Microbial diagnostics
  - Vaccine development
  - Zika
  - Preparing for next pandemic
  - Global health security

Table 3

AAP Brain science, circa 1900

1897: “on an epidemic of cerebrospinal meningitis caused by diplococcus intracellularis meningitides

- “3,000 cases of melancholia”

1888: “cerebral localization: practical aspects”

1899: “the application of thyroid extract in treatment of a cerebral neoplasm”

1914: “the microscopic evidence as to the organic nature of dementia praecox”

Table 4

Visualizing Medicine

1890: “Sphygmomograms for measurement of slow pulse”

1897: “Roentgen rays in thoracic disease”

1900: “a new modified sphygmograph”

1903: “the influence of the x-ray on metabolism in leukemia”

1908: “Fatigue in schoolchildren as tested by ergograph”

Table 5

Infectious Diseases at AAP meetings

1885:

- "Demonstration of bacterial cultures from a case of mycotic endocarditis in man, and of specimens showing the experimental production of disease in rabbits"
- "Certain elements found in the blood of malarial fever"

1886: treatment of anthrax in rabbits

- "Bacteriological examinations in acute endocarditis" – by Wm. H. Welch

1887:

- "antipyretic treatment and employment of antipyrin in treatment of typhoid fever"
- "forms of typhoid fever simulating remittent malarial fever"

1888: "Geographic distribution of typhoid fever in U.S."

- "Management of the stage of convalescence in typhoid fever"
- "Some forms of paralysis of the typhoid fever"
- "Micro and macro specimens of 'Bovine TB'"
- "Specimens of the microbe of syphilis"
- Dr. Welch demonstrated a series of microscopical specimens of the thyroid gland after partial extirpation; Dr. Prudden did the same from a case of myxedema

1890: "Relation of micro-organisms to inflammation and suppuration"

- "influence of soils in causation of disease"

1891: "What can and should be done to limit the prevalence of TB in man?"

- "A expert in sanitary administration for cholera in Glasgow 1866"

1891: "Relation of drinking water to disease"

1892: "Bacteriological study of drinking water"

- "Treatment of experimental TB by Koch's tuberculin"

1893: "Presentation of rabbits showing effects of tuberculin therapy" and "immunity conferred by inoculation of a bird with bacilli of tuberculosis"

1894: "Some of the chemical and bacteriological characteristics of milk"

- "Diminished prevalence of syphilis"
- "Some toxicogenic germs found in poisonous foods"

- “A Toxigenic germ found in ice cream and its chemical products”
- “a Statistical and experimental study of terminal infections

1899: “Some remarks on typhoid fever among the American soldiers in the recent war with Spain”

1900: “the existence of bacteria in normal tissue”

1903: “Transmission of bovine TB by milk”

1906: “the nature of spirochetes”

1908: “Importance and significance of negative blood cultures”

1909: the epidemiology, human pathology and animal pathology of acute anterior poliomyelitis

1914: “the occurrence of living tubercle bacilli in a river contaminated with sewage from a health resort”

Control of malaria by treating malaria carriers”

Table 6

Vaccines

1893: “Rabbits showing effects of tuberculin therapy conferred by inoculation”

1895: “Results of experiments of the neutralizing effects of the blood serum from a recently vaccinated calf upon the vaccine virus and upon vaccination”

1896: “Diphtheria antitoxin sometimes found in the blood of horses that have not been injected with toxin”

- “Diphtheria antitoxin obtained by electrolysis”

1898: “effects of freezing on diphtheria antitoxins”

1902: “Some experiments on the nature of the vaccine virus”

1909: “Vaccine therapy: general principles; in typhoid fever; in streptococcus infection; results of vaccine treatment”

1914: “the immunizing effect on swine of dessicated sensitized hog cholera virus”

Table 7

Principles of Public Goods

- Once provided, no one can be excluded from consuming them (*non-excludable)*;
- One person's consumption of them does not prevent anyone else's (they are *non-rival* in consumption)
  - Example: reduction in risk of infectious disease incidence
- No commercial incentive to produce these goods, since enjoyment cannot be made conditional on payment
  - Kaul I, Grunberg I, Stern MA; 1999; Smith RD, Bull WHO 2003

Table 8

Association of American Physicians Mission Statement

The Association of American Physicians established October 10, 1885, is an honorific, elected society of America's leading physician-scientists who exemplify the pinnacle of pioneering and enduring, impactful contributions to improve health.

The AAP seeks to inspire the full breadth of physician-led research across all fields of science related to medicine and health, and to build a community of physician scientists in support of the principle that objective science and evidence are essential foundations for improving patient care and the health of Americans.

Among other activities, AAP fulfills its mission by holding an annual meeting of physician-scientists to showcase and share science, and communicating on issues of science and practice for the public good. In partnership with other societies including the American Society for Clinical Investigation, AAP offers mentorship and role models for physician-scientists who are early in their careers.