

# Prof. Jose-Luis Jimenez

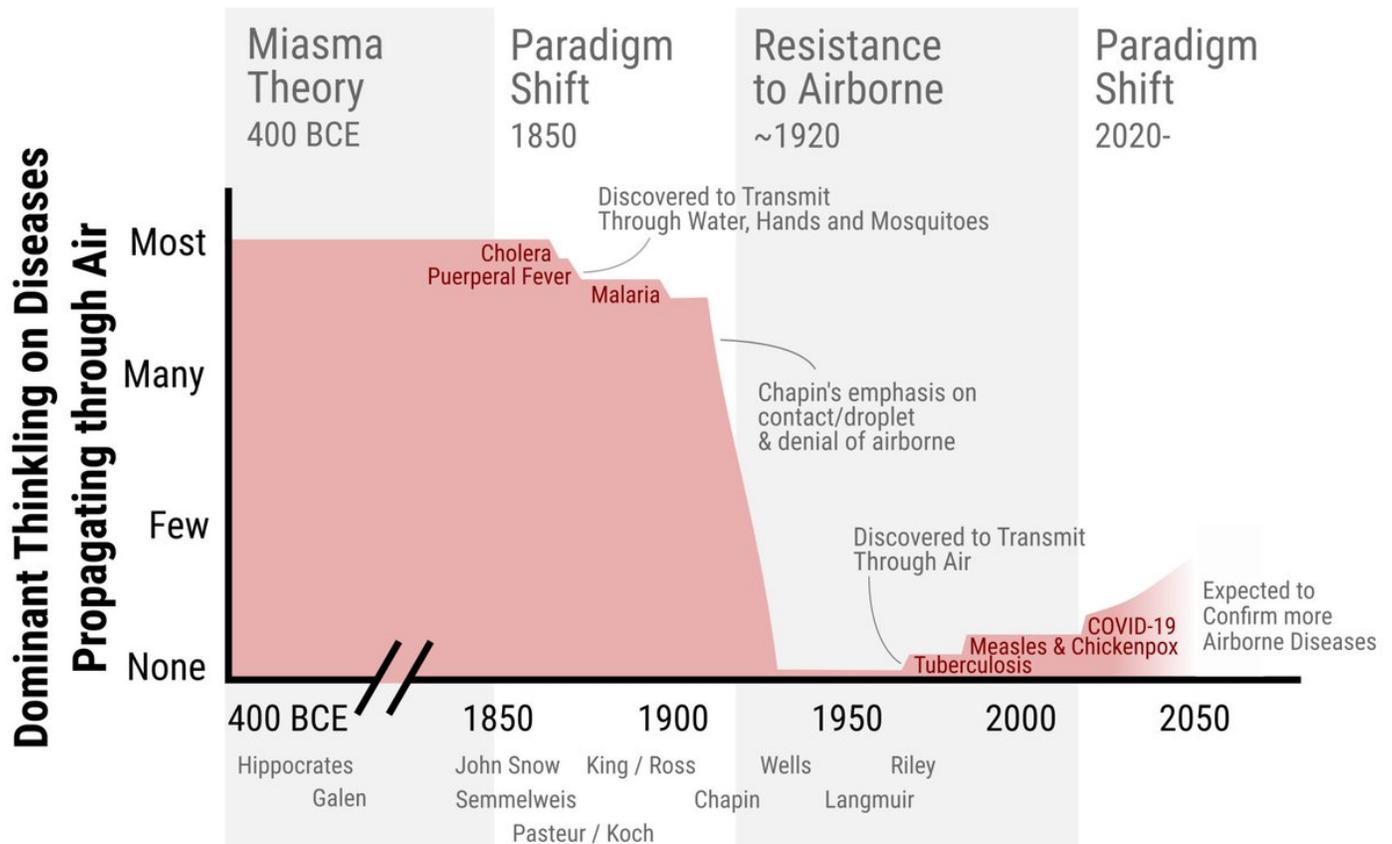
578 views

[Aug 23](#) • 142 tweets • 75 min read

1/ What were the historical reasons for the resistance to recognizing airborne transmission during the COVID-19 pandemic?

Our peer-reviewed open-access paper is now published:

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)



2/ Soon after COVID-19 pandemic started, it was clear to many scientists (inc. those who understand aerosols) that AIRBORNE trans. was an important contributor

E.g. as soon as we talked to the Skagit choir, it was obvious that was airborne-dominated:

3/ However, major public health organizations such as [@WHO](#) and [@CDCgov](#) were in complete denial, saying that airborne transmission was MISINFORMATION!

(Disgracefully, [@WHO](#) has not deleted this tweet or clearly stated that it was an ENORMOUS error)

World Health Organization (WHO) 



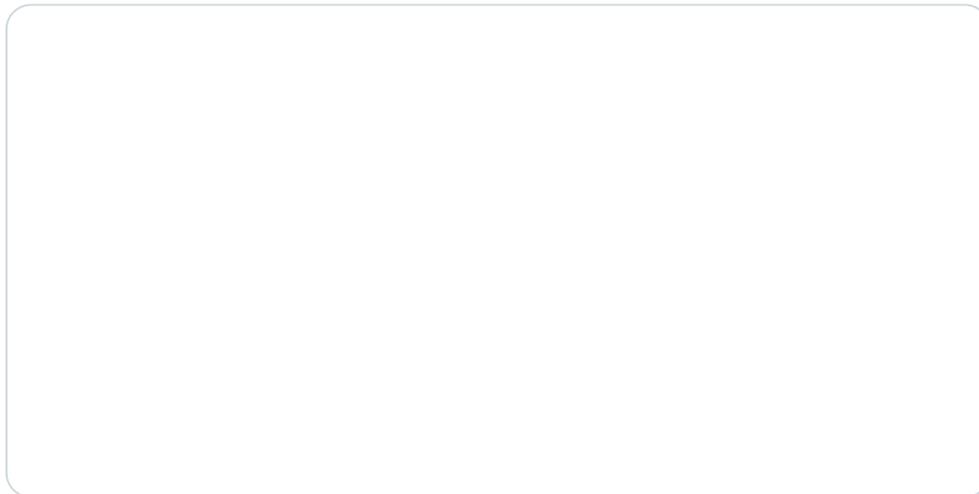
@WHO · [Follow](#)

FACT: **#COVID19** is NOT airborne.

The **#coronavirus** is mainly transmitted through droplets generated when an infected person coughs, sneezes or speaks.

To protect yourself:

- keep 1m distance from others
- disinfect surfaces frequently
- wash/rub your 
- avoid touching your   



12:44 PM · Mar 28, 2020



[Read the full conversation on Twitter](#)



44.2K



See the latest COVID-19 information on Twitter

[Read 2.8K replies](#)

# FACT CHECK: COVID-19 is NOT airborne

The virus that causes COVID-19 is mainly transmitted through droplets generated when an infected person coughs, sneezes, or speaks. **These droplets are too heavy to hang in the air. They quickly fall on floors or surfaces.**

You can be infected by breathing in the virus if you are within 1 metre of a person who has COVID-19, or by touching a contaminated surface and then touching your eyes, nose or mouth before washing your hands.

To protect yourself, keep at least 1 metre distance from others and disinfect surfaces that are touched frequently. Regularly clean your hands thoroughly and avoid touching your eyes, mouth, and nose.



This message spreading on social media is incorrect. Help stop misinformation. Verify the facts before sharing.



March 28 2020

#Coronavirus #COVID19

4/ How was that possible?

- Many scientists are concluding that airborne transmission is important
- Major public health organizations such as [@WHO](#) say that it is misinformation!

Historical trends and errors (this thread) are important to explain this, but NOT the only reason

5/ This major error (IMHO one of most important errors in the entire history of Public Health) has had major consequences:

- In early pandemic we focused on surfaces, which are minor or negligible
- we ignored air, which was the dominant mode

=> lack of controlling transmission

6/ Since then, research has clearly shown that airborne transmission is the DOMINANT mode of transmission of COVID-19:

[thelancet.com/article/S0140-...](https://www.thelancet.com/article/S0140-...)

7/ To this day, 0 proven cases of surface transmission

And droplet transmission has NEVER been demonstrated, not just for COVID-19... but for ANY disease in the history of medicine!

[Paper from Prof. Yuguo Li, member of [@WHO](#) IPC Committee]

[sciencedirect.com/science/articl...](https://www.sciencedirect.com/science/article/...)

Reviewing the literature on large droplet transmission, one can find no direct evidence for large droplets as the route of transmission of any disease. It is known that the infection risk of many respiratory infections

8/ So how did we get into this mess?

PH organizations tell us that unproven transmission mechanisms are dominant, and that the dominant trans. mechanism is misinformation

We'll soon delve into the history in our paper.

9/ But before we go into the history, there are other reasons to review.

Most importantly, surface-droplet transmission is very CONVENIENT to those in power. And AIRBORNE trans. is an inconvenient truth (just like climate change, dealt with similarly)

[telegraph.co.uk/global-health/...](https://www.telegraph.co.uk/global-health/...)

Policymakers and politicians also have a natural bias against the idea that diseases may be airborne, says Professor Jimenez.

“Droplets and surfaces are very convenient for people in power - all of the responsibility is on the individual,” he said. “On the other hand, if you admit it is airborne, institutions, governments and companies have to do something.”

10/ There is at least one more reason for the resistance:

those who made this enormous error at [@WHO](#), its IPC committee, [@CDCgov](#), & health ministries around the world DO NOT WANT to admit their error

Govt advisor privately: "we need to find a way to allow us to save face"  
11/ And those Public Health officials that continue to resist and obfuscate about airborne transmission are in control of the PH institutions.

Aerosol scientists are almost complete outsiders, and have been almost systematically excluded to this day.

[wellcomeopenresearch.org/articles/6-126](https://wellcomeopenresearch.org/articles/6-126)

**Results:**

Three fields—political, state (policy and regulatory), and scientific—were particularly relevant to our analysis. Political and policy actors at international, national, and regional level aligned—predominantly though not invariably—with medical scientific orthodoxy which promoted the droplet theory of transmission and considered aerosol transmission unproven or of doubtful relevance. This dominant scientific sub-field centred around the clinical discipline of infectious disease control, in which leading actors were hospital clinicians aligned with the evidence-based medicine movement. Aerosol scientists—typically, chemists, and engineers—representing the heterodoxy were systematically excluded from key decision-making networks and committees. Dominant discourses defined these scientists' ideas and methodologies as weak, their empirical findings as untrustworthy or insignificant, and their contributions to debate as unhelpful.

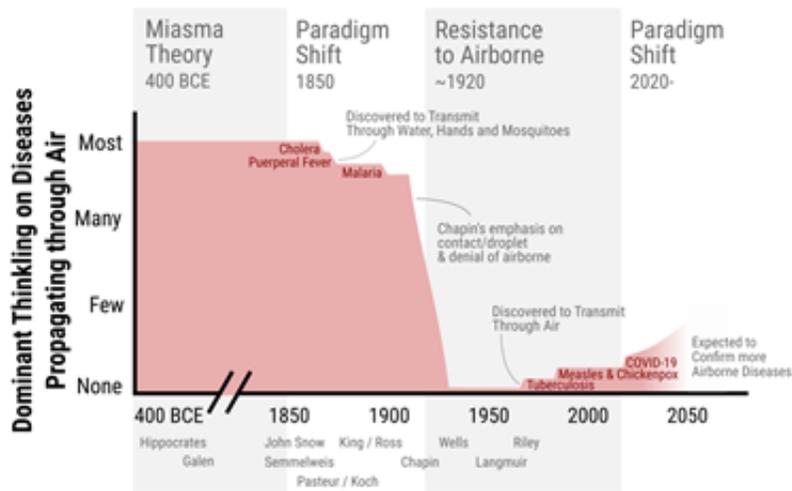
**Conclusion:**

The hegemonic grip of medical infection control discourse remains strong. Exit from the pandemic depends on science and policy finding a way to renegotiate what Bourdieu called the 'rules of the scientific game'—what counts as evidence, quality, and rigour.

12/ So what about the contribution of history to the denial of and resistance to airborne transmission by Public Health authorities worldwide?

It is summarized in this diagram, which I'll explain in this thread:

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)

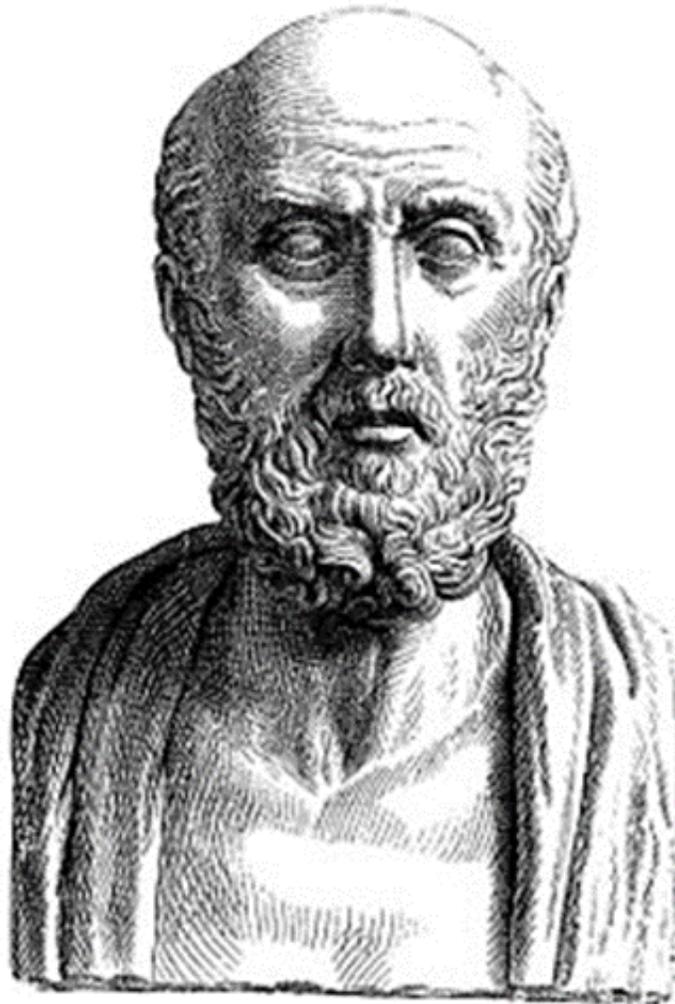


13/ Sorry, I need to take a break for some meetings (we are starting classes this week at [@CUBoulder](#)). I'll continue with the thread in 1 hr.

If you can't wait to read it, it is all in the paper:

14/ So to understand the errors that led to the denial and resistance of [#COVIDisAirborne](#), we need to go back to Hippocrates! (~400 BCE)

[en.wikipedia.org/wiki/Hippocrat...](https://en.wikipedia.org/wiki/Hippocrat...)



15/ Hippocratic writings in ancient Greece first proposed that diseases were caused by imbalance of humors in the body, which could be triggered by a "miasma" transmitted through the air

[loebclassics.com/view/hippocrat...](http://loebclassics.com/view/hippocrat...)

Whenever many men are attacked by one disease at the same time, the cause should be assigned to that which is most common, and which we all use most. This it is which we breathe in. For it is

16/ Throughout much of subsequent human history, the belief persisted that diseases were transmitted through air

Because the actual agents remained a mystery for centuries, explanations were given in general terms such as "miasmas," or "bad air"



17/ For example, the etymological root of the term "malaria" (a disease that we now know is transmitted by mosquitos) is "mala aria," medieval Italian for "bad air"

17/ Some origin theories were more specific. E.g. Roman scholar Varro (116–27 BCE) wrote that swamps were a particular breeding ground for minute creatures that "float in the air and enter the body through mouth & nose and there cause serious diseases."

18/ Thus it became a policy of the Roman Empire to drain swamps, removing breeding grounds for mosquitos, reducing malaria, an example of a mistaken theory giving good results

and increasing faith on the theory

We see this many times through history

19/ The concept of person-to-person contagion came much later, most clearly in work of Italian physician Girolamo Fracastoro in 1546

[This is actually a subject of current debate, with some scholars thinking that the role of F may have been overstated]

[en.wikipedia.org/wiki/Girolamo\\_...](https://en.wikipedia.org/wiki/Girolamo_Fracastoro)



20/ What ensued after Fracastoro, however, was a centuries-long debate between "miasmatists," who held fast to the idea that diseases floated through the air over distances, and "contagionists," who accepted person-to-person spread of disease

21/ Because it was (and it still IS) very difficult to determine how, why, and

from where someone became infected, the miasmas vs. contagion debate failed to reach a resolution and persisted for centuries.

22/ A middle ground was proposed, "contingent contagionism": malaria, or cholera might be contagious in an impure atmosphere, but not in a healthy atmosphere

This idea therefore captured some grains of truth (eg. now we know ventilation reduces airborne)

23/ Miasma theory was dominant till the mid/late 19th Century. Florence Nightingale (1820–1910) like most Victorians was raised to believe that diseases were caused by 'miasma' or foul air.

[en.wikipedia.org/wiki/Florence...](https://en.wikipedia.org/wiki/Florence_Nightingale)



24/ In her Notes on Hospitals, Nightingale referred to the idea of contagion

as absurd:

[She was nevertheless very practical and effective in reducing disease, e.g. with ventilation and phys. distance, and later accepted germ theory, as we'll see later]

[play.google.com/store/books/de...](https://play.google.com/store/books/de...)

In her *Notes on Hospitals*, she wrote: "What does 'contagion' mean? It implies the communication of disease from person to person by *contact*. [...] There is no end to the absurdities connected with this doctrine. Suffice it to say that [...] there is no proof [...] that there is any such thing as 'contagion'. Infection acts through the air. Poison the air breathed by individuals, and there is infection."<sup>52</sup>

25/ We enter a critical period around 1850. Miasma theory is still dominant, although contagion (mostly through the air) also has proponents.

Microorganisms have been observed for 2 centuries since the invention of the microscope, but haven't clearly been connected to disease

26/ Cholera strikes London in 1854.

The public health establishment believed it to be caused by a miasma. English sanitary reformers (e.g. Chadwick), who initiated many modern public health practices, found miasma appealing, as it appeared to explain...

[en.wikipedia.org/wiki/Edwin\\_Cha...](https://en.wikipedia.org/wiki/Edwin_Cha...)



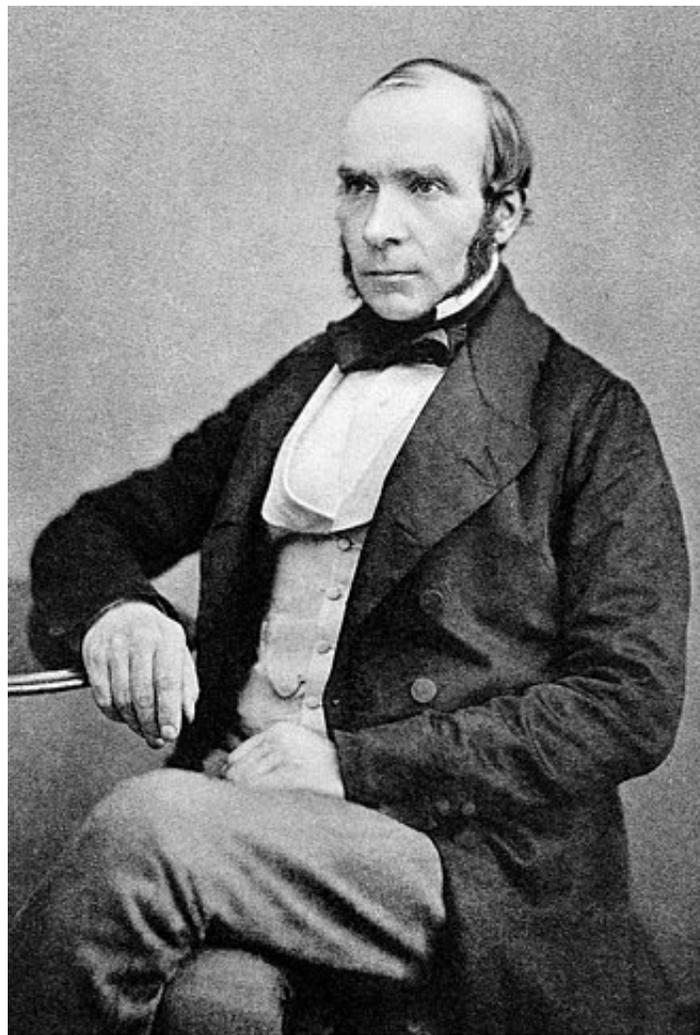
27/ ...the prevalence of diseases in the undrained, filthy, and foul-smelling areas where the poor lived, and helped justify their efforts to address those conditions.

[They had made a huge error, and they resisted accepting it, just as [@WHO](#) today]

28/ John Snow was a wealthy doctor but outsider to public health.

His work in anesthesia made him familiar with the behavior of gasses. He realized that the spread of cholera was NOT consistent with what would be expected for a gas.

[en.wikipedia.org/wiki/John\\_Snow](https://en.wikipedia.org/wiki/John_Snow)



29/ Snow noticed how cases had clustered in a specific London borough and persuaded the local council to remove the handle of the Broad street water pump, which halted the epidemic.

[archive.org/details/b28985...](https://archive.org/details/b28985...)

[ph.ucla.edu/epi/snow/snowc...](https://ph.ucla.edu/epi/snow/snowc...)

[blog.rtwilson.com/john-snows-cho...](https://blog.rtwilson.com/john-snows-cho...)



30/ However, cholera was already in decline. The Board of Health refused to accept contaminated water, stating:

“we see no reason to adopt this belief [that cholera was water-borne]”

and dismissing Snow's conclusions as mere “suggestions”

[google.com/books/edition/...](https://www.google.com/books/edition/...)

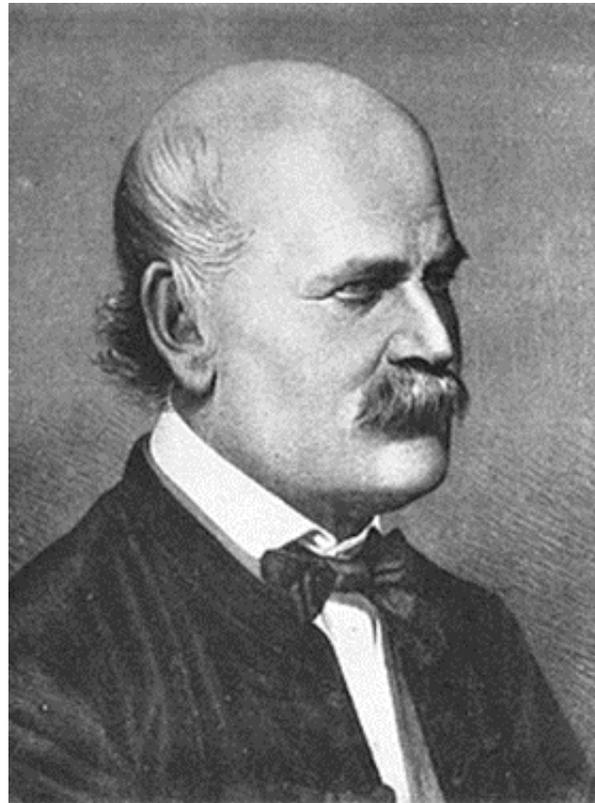
31/ The Board of Health had strong incentives for rejecting water as the source of cholera. To remove the sources of the miasma (filth), they had spearheaded the effort to build sewers that dumped raw sewage into the Thames, the source of much of London's drinking water...

32/ ...thus effectively helping the spread of cholera. They had much to lose by admitting cholera transmitted through water

[Technology has advanced, but human nature has changed less. [@WHO](#) has avoided saying LOUD & CLEAR that [#COVIDisAirborne](#), as their denials helped it spread]

@mentions 33/ Also around 1850, Ignaz Semmelweis in Vienna showed that handwashing greatly reduced deaths by childbed fever in a maternity clinic.

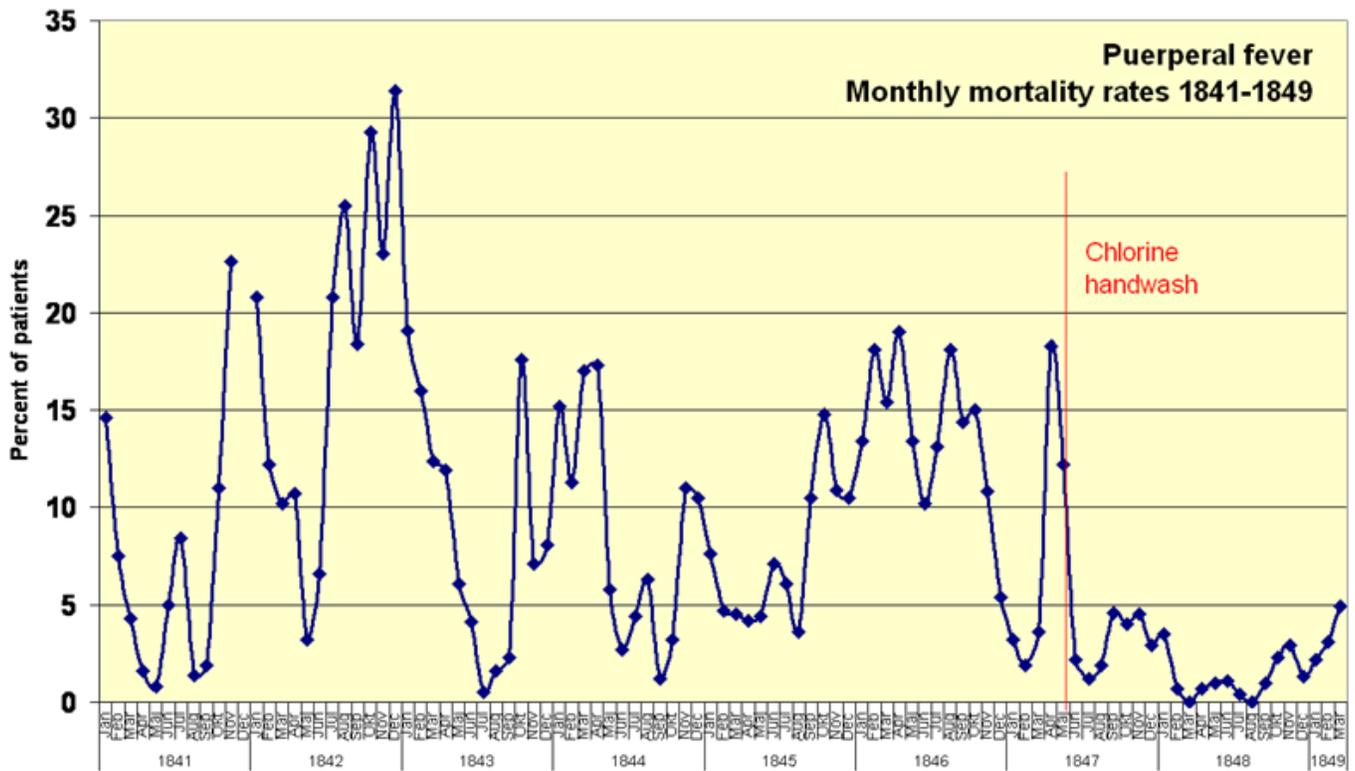
[en.wikipedia.org/wiki/Ignaz\\_Sem...](https://en.wikipedia.org/wiki/Ignaz_Semmelweis)



34/ These are some of Semmelweis' data, which would seem worth following up on:

However, his ideas conflicted with established medical and scientific beliefs that STILL described diseases as due to an imbalance of humors triggered by a miasma in the air.

[doi.org/10.1556/650.20...](https://doi.org/10.1556/650.20...)



35/ However, he was dismissed from his hospital and harassed by Vienna medical community, forced to move to Budapest. There he broke down, was interned and beaten by the guards, and ultimately died from an infected wound

Like Snow, he died years before his theories were accepted

36/ Ironically, Semmelweis' name lives on not only for advances of hand sanitation, but also in "Semmelweis reflex," which describes the reflex-like tendency to reject new knowledge or evidence when it contradicts established beliefs, norms, or paradigms

37/ That is especially ironic, as the chief deniers of airborne transmission (John Conly -- chairman of key IPC [@WHO](#) committee, Dr. Seto, [@DidierPittet](#), [@CollignonPeter](#)) are handwashing experts...

... following Semmelweis' scientific advances, while forgetting about the reflex

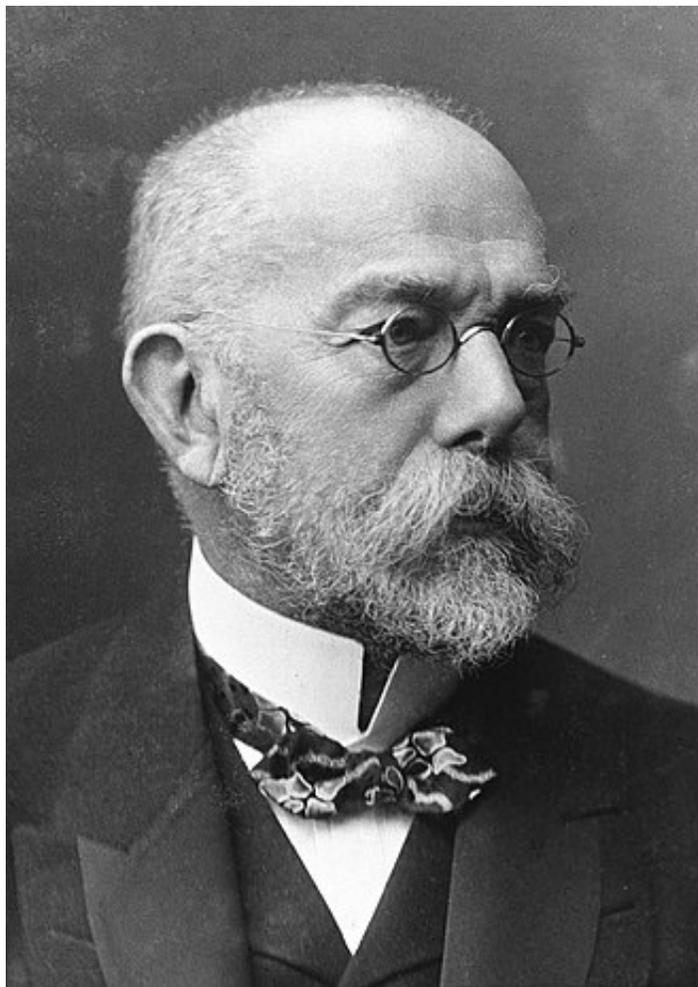
38/ The 2nd half of the 19th Century is a period of rapid progress on disease transmission.

Pasteur and Koch proposed the GERM THEORY of disease. Microscopic germs enter the body and are the cause of many diseases.

[en.wikipedia.org/wiki/Germ\\_theo...](http://en.wikipedia.org/wiki/Germ_theo...)

[worldcat.org/title/memoire-...](http://worldcat.org/title/memoire-...)





39/ Germ theory was NOT accepted overnight.

E.g. experiments by others in which water containing organic matter was boiled in a vessel, but microorganisms still appeared (later shown to be an imperfect seal or insufficient boiling) created controversy:

40/ However, by the late 1880s, miasma theory was waning in popularity, and in 1888, the Institut Pasteur was created in Paris, reflecting the ascendancy of germ theory.

41/ Florence Nightingale did accept the new ideas of germ theory, in fact before many physicians did.

E.g. in 1882, she wrote:

[books.google.com/books?id=dDDcy...](https://books.google.com/books?id=dDDcy...)

“Always have chlorinated soda for nurses to wash their hands, especially after dressing or handling a suspicious case. It may destroy germs at the expense of the cuticle, but if it takes off the cuticle, it must be bad for the germs.”<sup>63</sup>

42/ Initial results on plant pathogens in 1890s & the identification of bacteriophage in 1917 paved the way for recognition of viruses.

A “golden era” followed, with the identification of the actual microorganisms that cause many infectious diseases.

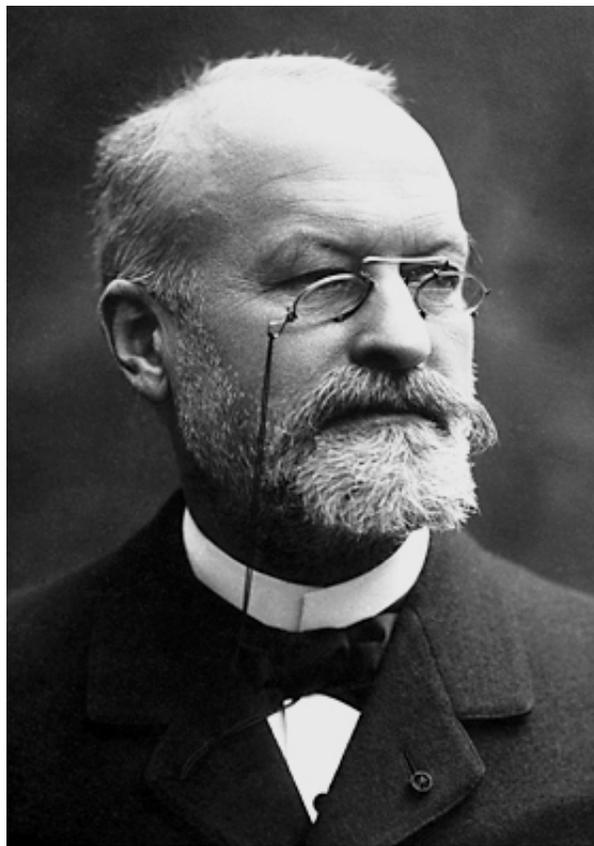
43/ The discovery and identification of the organisms causing different diseases did NOT, however, eliminate the great difficulty in conclusively determining the mode by which they transferred from one person to another.

Malaria was still thought to go through the air in 1880

44/ French physician Charles Laveran identified the pathogen responsible for malaria in 1880 (got Nobel Prize in 1907), but the manner of transmission was still thought to be through the air.

[doi.org/10.1186/1475-2...](https://doi.org/10.1186/1475-2...)

[en.wikipedia.org/wiki/Charles\\_L...](https://en.wikipedia.org/wiki/Charles_L...)

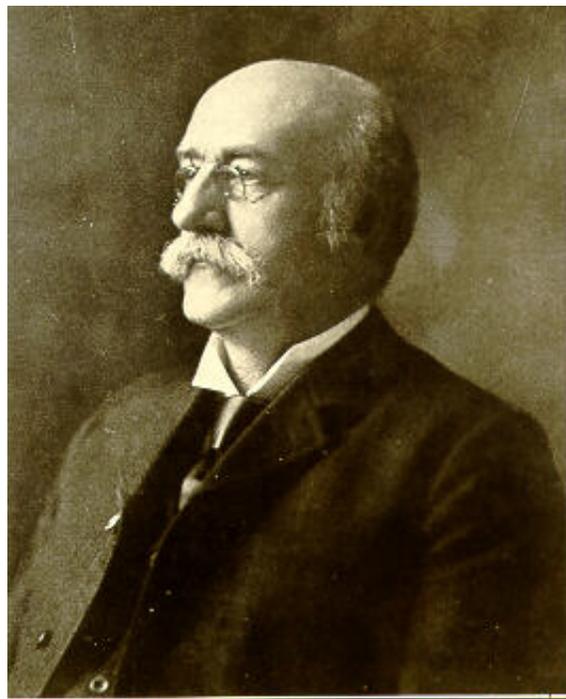


45/ American physician A. King proposed that malaria was transmitted by mosquitos, but encountered general skepticism

In 1883, he presented a list of 19 facts supporting m. as vector of malaria

[Reminds me of 10 scientific reasons for [#COVIDisAirborne](#)]

[en.wikipedia.org/wiki/Albert\\_Fr...](https://en.wikipedia.org/wiki/Albert_Fr...)



DR. ALBERT FREEMAN AFRICANUS KING.

46/ In 1898 British surgeon R. Ross provided definitive evidence:

- confirming the presence of the malarial parasites in mosquitoes
- demonstrating transmission of bird malaria by mosquitoes

World Mosquito day commemorates him

[doi.org/10.1186/1475-2...](https://doi.org/10.1186/1475-2...)

[en.wikipedia.org/wiki/Ronald\\_Ro...](https://en.wikipedia.org/wiki/Ronald_Ro...)

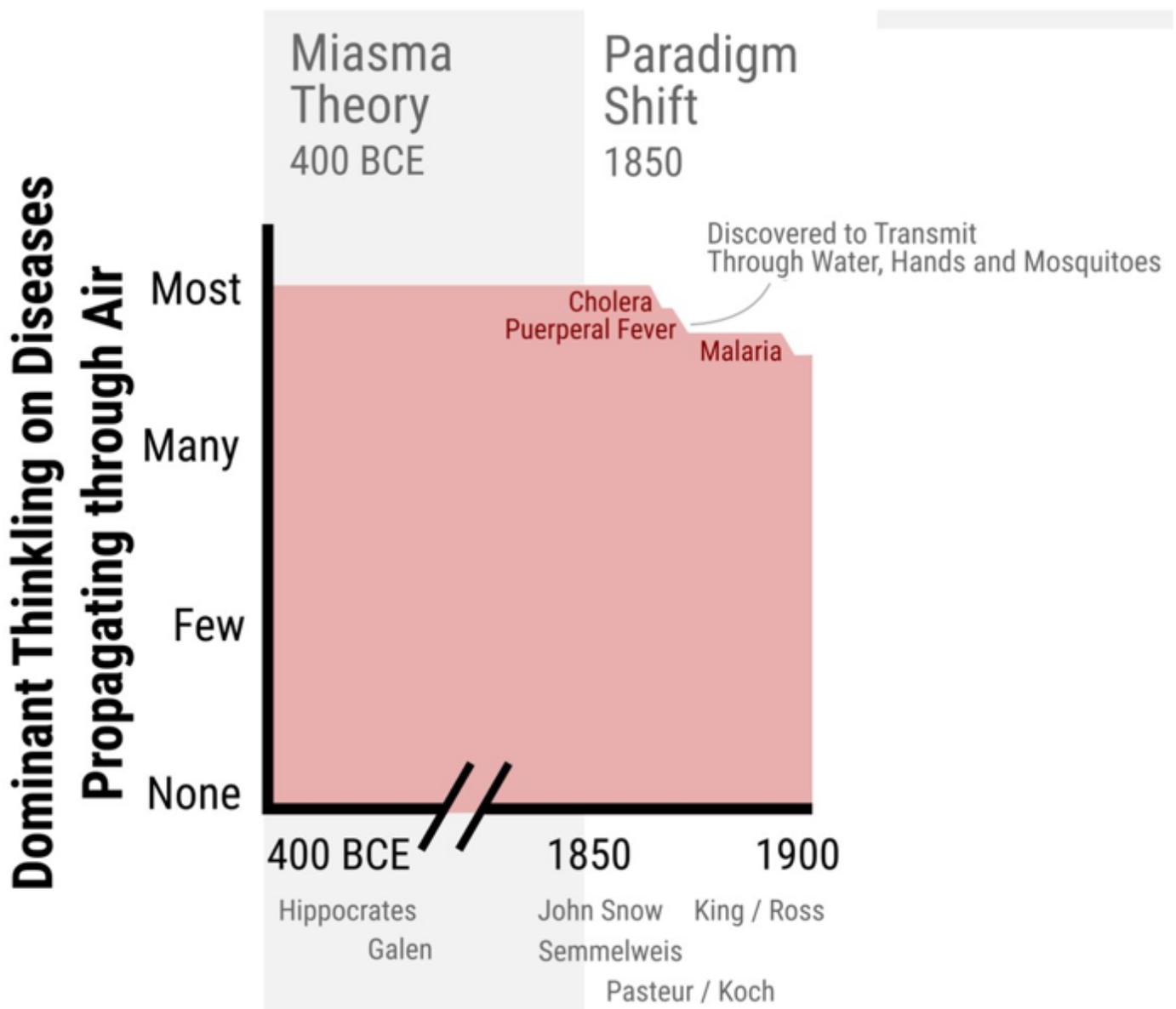


47/ Looking back at period 1850-1900, belief on transmission of many diseases through AIR was still strong

But cholera, malaria, puerperal fever had been shown to transmit  
OTHERWISE

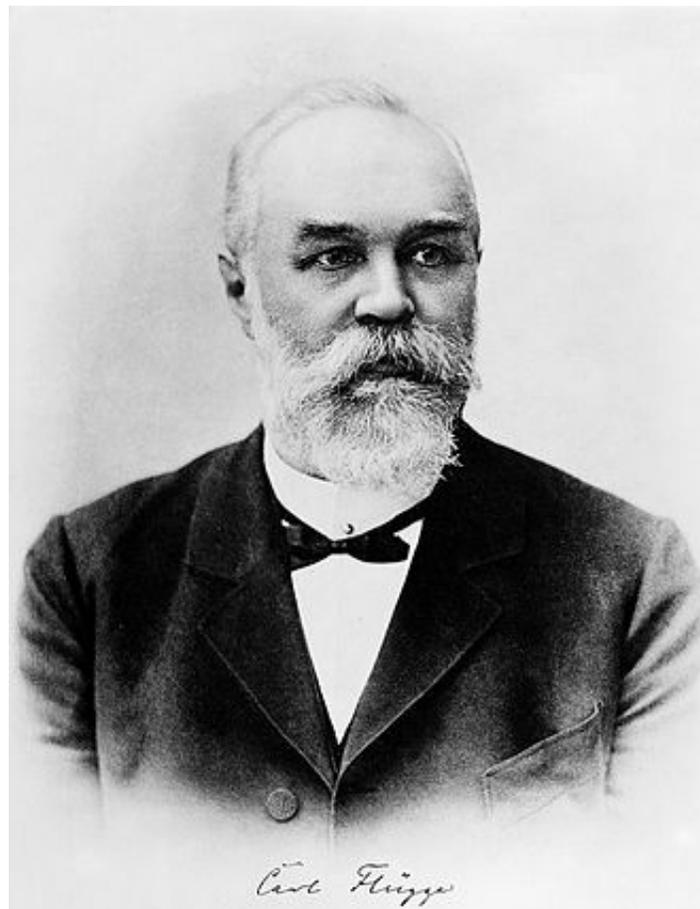
It was a fluid time. It was debated if air was actually important

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)



49/ ...blankets, bowls, & other objects was dispersed into air. In contrast, Flügge thought that it was not DRIED secretions from sick that caused infection, but rather FRESH secretions that ppl were exposed to IN AIR BEFORE they reached the ground

[doi.org/10.1098/rsfs.2...](https://doi.org/10.1098/rsfs.2...)



50/ Some contemporaries of Flügger such as Cornet argued that tuberculosis was transmitted only through large droplets, which were easily visible to the naked eye.

Perhaps because droplets were more CONVENIENT and airborne disease VERY INCONVENIENT?

[google.com/books/edition/...](https://www.google.com/books/edition/...)

was very concerned about the social implications of infected air, stating "If not only the sputum, but the exhaled air [...] contains bacteria, then we have no choice but to put our feet on our laps and be resigned, his fate reaches us too with an infected breath. Terrible then is the fate of those suffering [...] like the lepers of earlier centuries have to be expelled from human society."

51/ However, although term "Flügger's droplets" has been used to describe ONLY those large particles that fell to the ground quickly near the infected person and that were assumed to dominate transmission, that does NOT accurately capture Flügger's results

52/ Rather, Flügge and collaborators used the term "droplet" to refer to fresh particles of ALL SIZES, including AEROSOLS for which the researchers waited 5 hours to settle from the air on their collection plates.

53/ In 1905, microbiologist M.H. Gordon was commissioned to study the atmospheric hygiene of the UK House of Commons after an epidemic of influenza among members

He famously performed the following experiment: after gargling with a broth culture of *Serratia marcescens*...

54/ ... he loudly recited passages from Shakespeare in an empty House to an audience of agar plates. Although growth of colonies was more numerous on plates near the speaker, cultures were apparent on some plates over 21 m away.

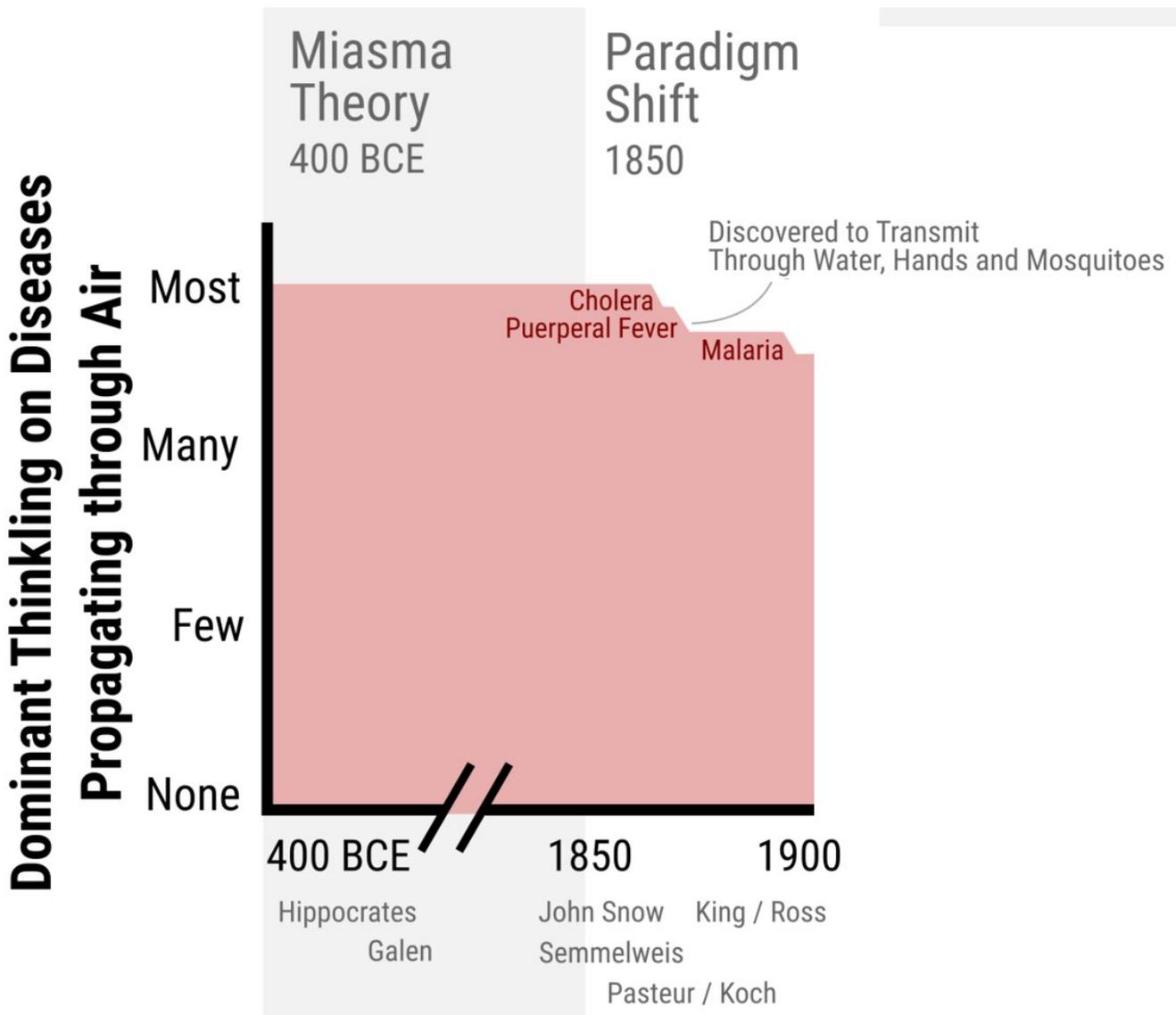
55/ However, experimental progress in early 1900s was hampered by the limitations of the experimental techniques available at the time. In particular high-quality measurements of large droplets & aerosols would only be routinely available decades later.

56/ We get to the CRITICAL POINT of this history.

Throughout most of human history, the dominant belief was transmission of many diseases through the air.

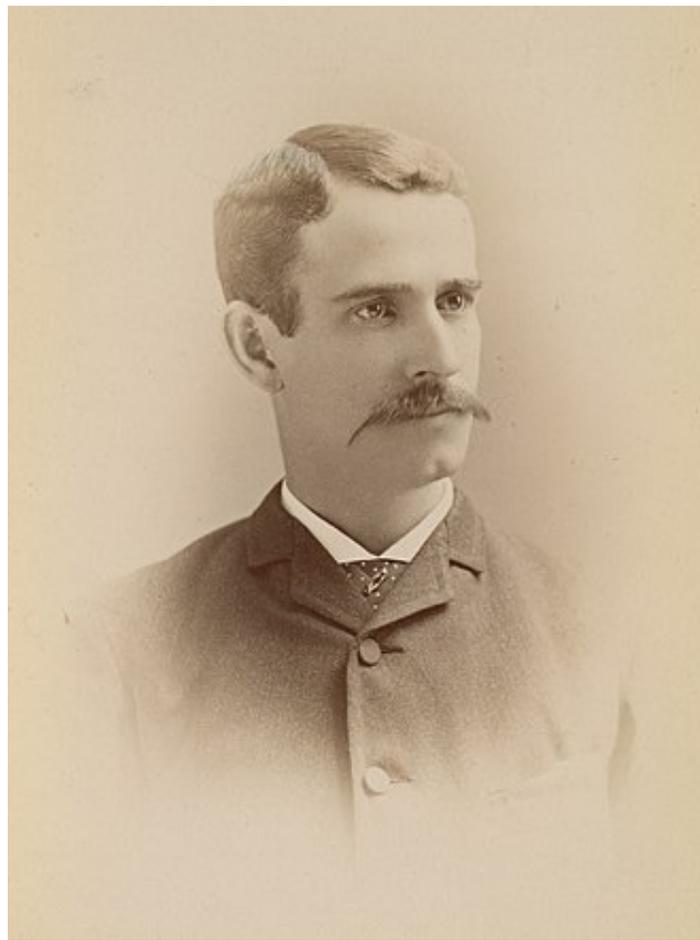
The last half of the 19th Century proves otherwise for major diseases.

Strong debate ensues: "is air major or minor?"



57/ Charles V. Chapin was a prominent American epidemiologist. He worked only a couple of decades after Germ Theory was accepted, during a period of intense research on pathogens & their transmission.

[en.wikipedia.org/wiki/Charles\\_V...](https://en.wikipedia.org/wiki/Charles_V...)



58/ The period when Chapin's worked on disease transmission was a fluid one, following a major paradigm shift, in which it was easier to change the dominant scientific discourse than during normal times

[See e.g. Kuhn [en.wikipedia.org/wiki/The\\_Struct...](https://en.wikipedia.org/wiki/The_Structure_of_Scientific_Revolution)]

59/ He summarized the evidence of transmission of different diseases in his 1910 seminal book, "The Sources and Modes of Infection."

[A must read if you are interested in this subject, esp. chapter on airborne transmission]

[play.google.com/store/books/de...](https://play.google.com/store/books/details/)

THE

**SOURCES AND MODES  
OF  
INFECTION**

**By**

**CHARLES V. CHAPIN, M.D., Sc. D.**

**SUPERINTENDENT OF HEALTH, PROVIDENCE, R. I.  
AUTHOR OF "MUNICIPAL SANITATION IN THE UNITED STATES"**

***SECOND EDITION REVISED AND ENLARGED***  
**TOTAL ISSUE FOUR THOUSAND**

**NEW YORK**  
**JOHN WILEY & SONS, Inc.**  
**LONDON: CHAPMAN & HALL, LIMITED**  
**1916**

60/ Chapin conceptualized "contact infection," infection by germs that did

NOT come from the environment, but from other PEOPLE through DIRECT CONTACT OR CLOSE PROXIMITY.

[play.google.com/books/reader?i...](https://play.google.com/books/reader?i...)

## CHAPTER IV.

### INFECTION BY CONTACT.

**Most Obvious Mode.** — Contact infection is the most obvious mode of transmission of the infectious diseases. For the sick to touch the well, and thus infect them, seems to be the most natural way of accounting for the spread of these diseases. If contact infection can explain epidemiological phenomena, there is no occasion for assuming the growth of pathogenic germs outside of the body, or of infection by fomites or infection by air, or any other similar theory, and no such theory should be adopted as a working hypothesis unless pretty strong evidence can be brought to its support.

61/ Chapin believed contact was main mode of transmission of many diseases

But he encountered resistance: "I have sometimes been told I lay too much emphasis on contact infection [although] until recently very little attention has been paid to it."

62/ Chapin also reviewed the possibility of airborne infection, which he conceived especially as infections from afar. Lingering belief on air infection was making it difficult to promote contact infection:

[play.google.com/books/reader?i...](https://play.google.com/books/reader?i...)

In reviewing the subject of air infection it becomes evident that our knowledge is still far too scanty, and that the available evidence is far from conclusive. Yet it is of the greatest practical importance that we should know definitely just what danger there is of air-borne infection and in what diseases it is to be feared. Infection by air, if it does take place, as is commonly believed, is so difficult to avoid or guard against, and so universal in its action, that it discourages effort to avoid other sources of danger. If the sick-room is filled with floating contagium, of what use is it to make much of an effort to guard against contact infection? If it should prove, as I firmly believe, that contact infection is the chief way in which the contagious diseases spread, an exaggerated idea of the importance of air-borne infection is most mischievous. It is impossible, as I know from experience, to teach people to avoid contact infection while they are firmly convinced that the air is the chief vehicle of infection.

63/ Chapin realized that airborne infection may explain infection in close proximity (CP). However, he argued that ease of infection in CP was better explained by "spray-borne" droplets, large visible droplets considered by Cornet

Same as [@WHO](#)'s droplets:

World Health Organization (WHO) 

@WHO · [Follow](#)



Replying to @WHO

Watch this short animation to learn more about **#COVID19**,  
how it spreads and how to protect yourself against it.  
**#coronavirus**

Watch on Twitter

7:41 AM · Mar 29, 2020



2.9K



See the latest COVID-19 information on Twitter

[Read 197 replies](#)

64/ This is the key. The evidence was insufficient, but Chapin turned absence of evidence into evidence of absence, and stated that airborne disease was almost impossible, and that "mouth spray" (large droplets) are only effective at short distances.

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)

Chapin stated that “[t]here is no evidence that [airborne transmission] is an appreciable factor in the maintenance of most of our common contagious diseases.” And critically, he turned (an already not completely correct claim of) absence of evidence into evidence of absence. “We are warranted then, in discarding [airborne transmission] as a working hypothesis, and devoting our chief attention to the prevention of contact infection,” he concluded. “It will be a great relief to most persons to be freed from the specter of infected air, a specter which has pursued the race from the time of Hippocrates.” He later summarized his conclusions in a review in the prominent J. Am. Med. Assoc., stating that “There is little evidence that, among the diseases which commonly occupy our attention in this part of the world, aerial transmission is a factor of importance. [...] We may be sure that the sewer gas bogey is laid, the notion that dust is a dangerous vehicle of every-day infection is unsupported and that mouth spray is usually effective only at short distances.” He only left open the possibility for tuberculosis, although “the last word has not been said.”<sup>75</sup>

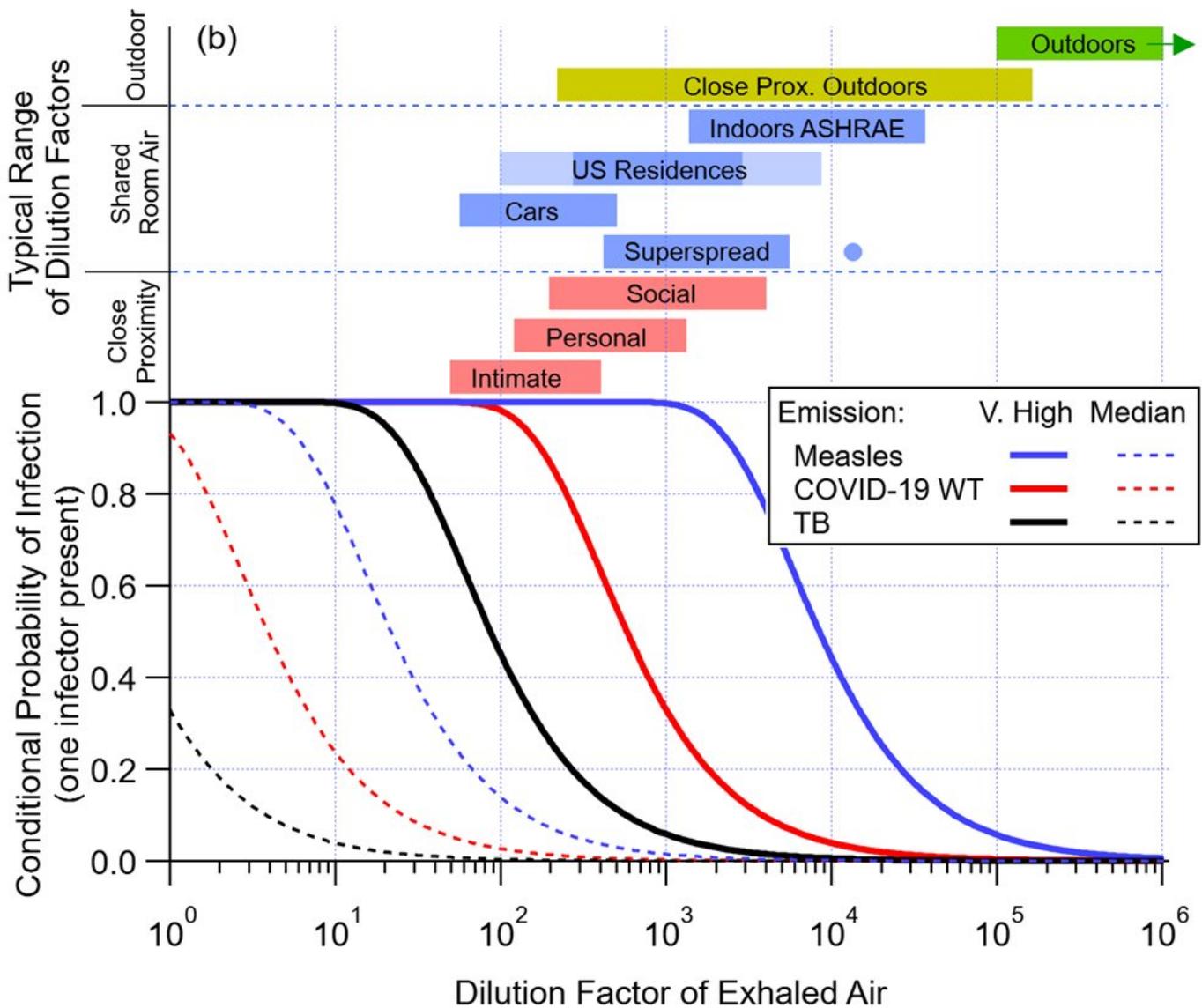
65/ As we have explained in another recent paper, Chapin conflates an empirical fact ("distance reduces transmission") with a mechanism: GRAVITY, which makes the droplets fall close to the infected person.

66/ Problem: the more correct explanation (of why distance reduces trans.) is NOT gravity but DILUTION:

Like exhaled smoke, you breathe less exhaled air farther from someone.

And error in PHYSICS made by MEDICAL professionals who do not study physics!

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)



67/ Despite the lack of evidence, Chapin was too successful.

He was much better positioned than Snow or Semmelweis as the long-serving Health Officer of Providence and w/ success of reducing contact transmission in a new hospital. In 1927, he became President of [@PublicHealth](#)

68/ Chapin was described in 1967 as "the greatest American epidemiologist" by A. Langmuir, 1st & long-time director (1949–1969) of epidemiology branch of [@CDCgov](#)

As late as the 1980s, Chapin's views were dominant there.

[doi.org/10.1093/aje/14...](https://doi.org/10.1093/aje/14...)

[en.wikipedia.org/wiki/Alexander...](https://en.wikipedia.org/wiki/Alexander...)



69/ CRITICALLY, Chapin's unproven hypothesis was accepted as true:

Ease of infection in close proximity is accepted proof of transmission from sprayed droplets

This KEY ERROR conditioned the evolution of this field over the next century, and into the COVID-19 pandemic

69/ The 1918 flu led to lots of work and discussion in this area, but did not blunt the ascendance of of Chapin's theory:

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)

Influenza, thought in the 15th century to be caused by the noxious influence of winter constellations (“influenza delle stelle”), can cause severe pandemics when a significantly different strain emerges through genetic evolution. The most severe pandemic by far in the 20th century was that of 1918 (“Spanish Flu”). In the early stages of the pandemic, a warning from the US Surgeon General published in newspapers across the United States warned of “germs being carried with the air along with the very small droplets of mucus, expelled by coughing or sneezing, forceful talking, and the like.”<sup>81</sup> The dangers of infection thus justified public health recommendations for the public to cover their coughs, avoid crowds, and wear masks when in the same room as infected persons. There was some evidence that ventilation and outdoor air reduced transmission, which suggested airborne transmission. For example, some cities such as Chicago implemented public health measures strongly focused on ventilation, including in schools, churches, and rooms where patients were being treated; places of public gathering, such as dance-halls and theaters, were closed until thorough renovation works were carried out as a condition for a permit to reopen. Chicago had been the first city to adopt ventilation ordinances in public buildings and conveyances (including street cars) and in workplaces in 1910. The city reopened within 6 weeks and did not have a second wave of pandemic,<sup>82</sup> although it may have fared better than other cities for a combination of reasons. However, the limited nature of the understanding of pathogen transmission that emerged during the pandemic was not enough to force a paradigm shift, and Chapin's ideas became firmly established over the next two decades.

70/ In the 1930s, Harvard engineering professor William Wells and physician Mildred Wells, his wife, started applying more contemporary experimental methods to the investigation of airborne transmission.

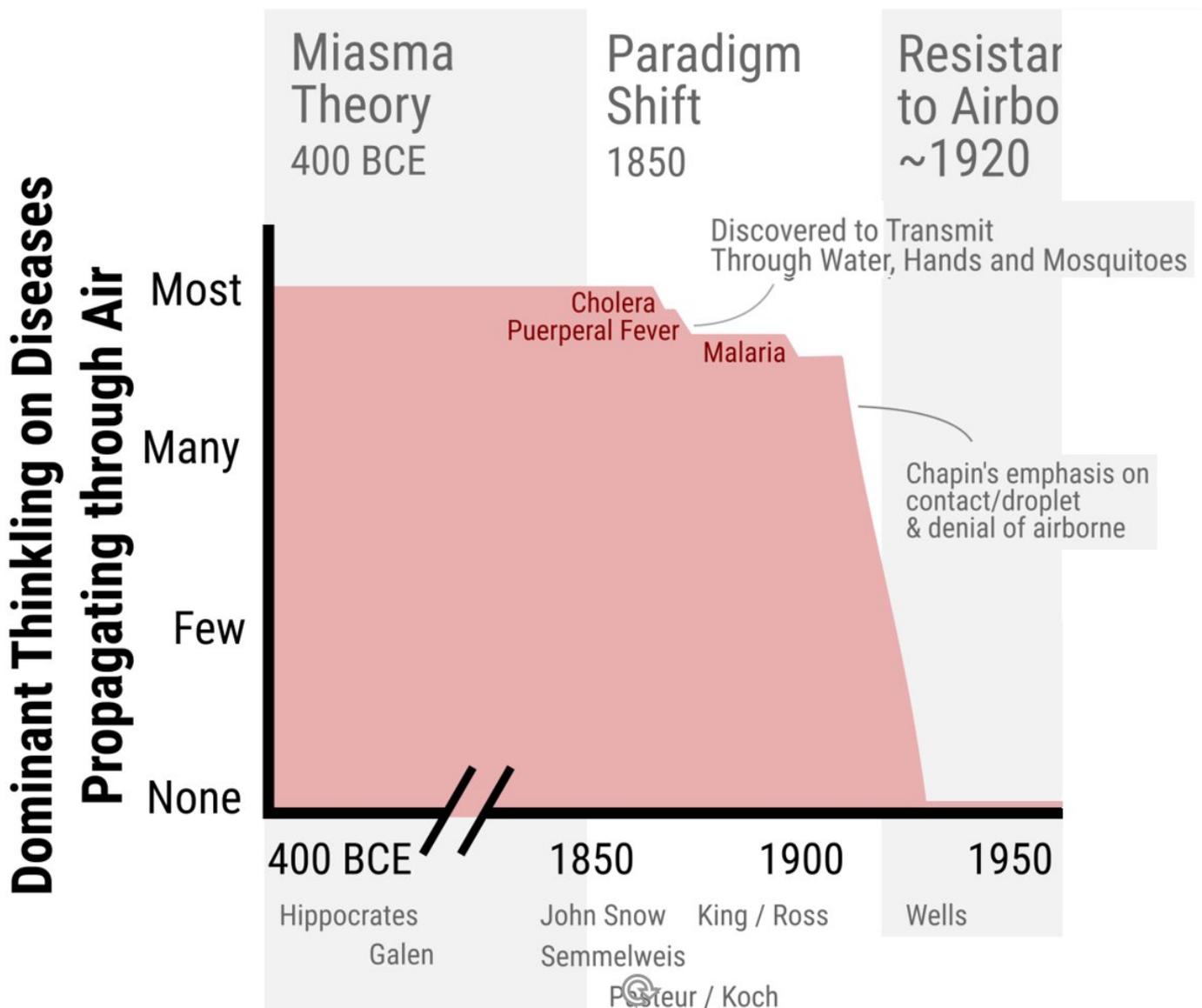
[en.wikipedia.org/wiki/William\\_F...](https://en.wikipedia.org/wiki/William_F...)



71/ But Chapin had successfully shifted the paradigm and his theory was now viewed as scientific progress.

The Wellses were accused of a retrograde approach to science, which sought to bring back the miasma theory.

[jamanetwork.com/journals/jama/...](http://jamanetwork.com/journals/jama/...)



72/ Wells was 1st to rigorously study size of sprayborne droplets vs. airborne aerosols

Conceptualized dichotomy of sprayborne droplets ( $\geq 100 \mu\text{m}$ ), reach the ground before drying

Vs. aerosols ( $\leq 100 \mu\text{m}$ ), dry before they reach ground ( "droplet nuclei" )

[academic.oup.com/aje/article-ab...](http://academic.oup.com/aje/article-ab...)

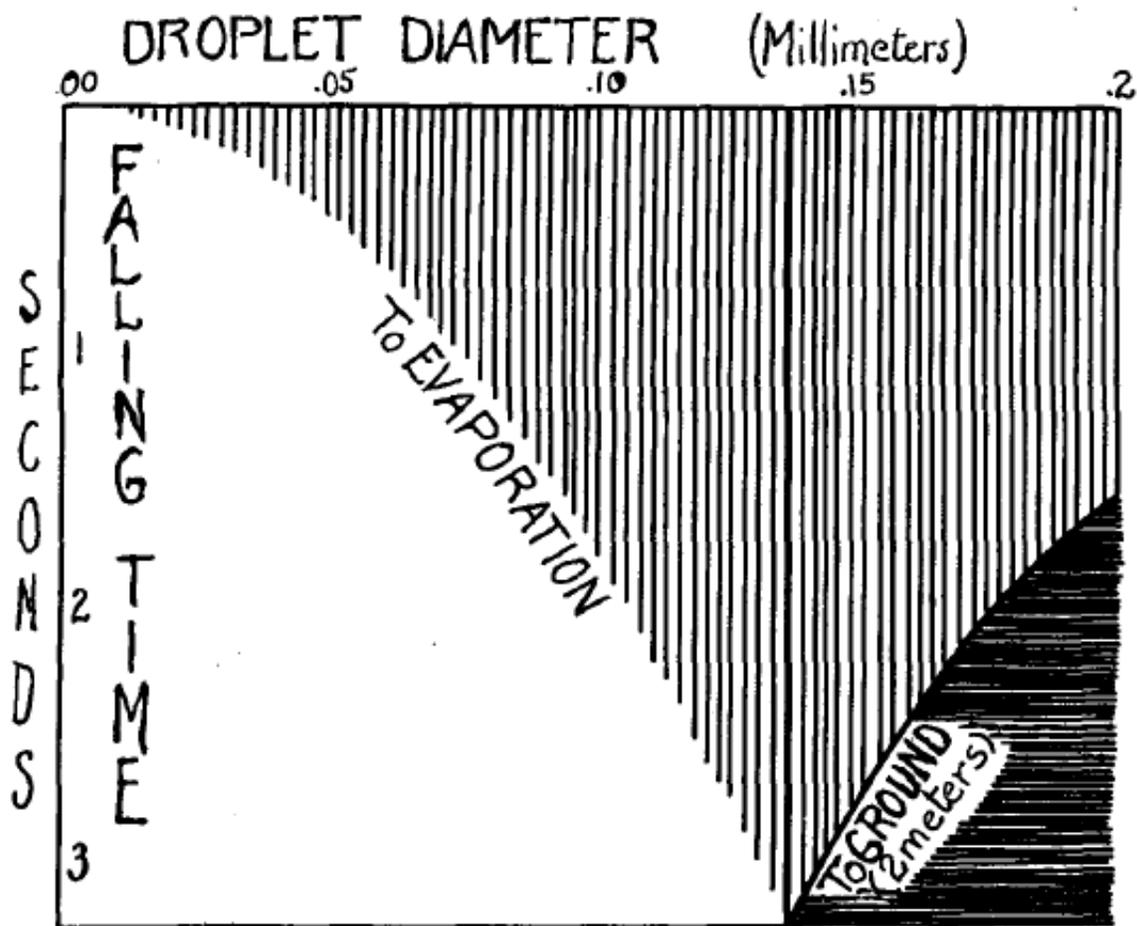


CHART 1. Falling times and evaporation times of droplets of varying diameter.

73/ Wells understood connection w/ meteorology where this is common knowledge, stating:

"A raindrop 2 mm in diameter can fall miles without completely evaporating under conditions which would cause a 0.2 mm droplet to evaporate before it had fallen from the height of a man."

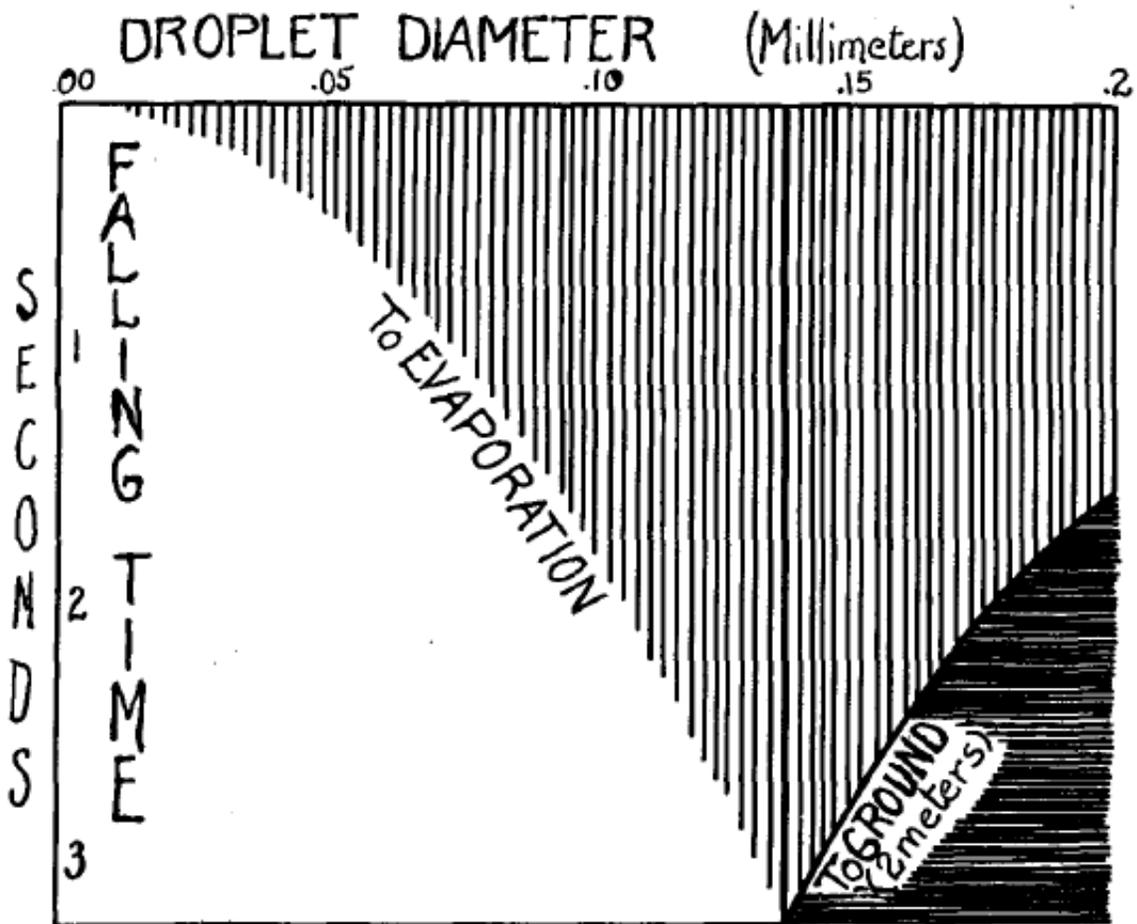


CHART 1. Falling times and evaporation times of droplets of varying diameter.

@mentions 75/ We pointed out this glaring error many times. I.e. see that even at 50 microns, they don't fall quickly:

Not too important per se, but makes glaringly obvious the ignorance of physics by those in charge at and its IPC committee.

**Ryan Davis**

@MicroLevigator · [Follow](#)



Much discussion lately in aerosol/disease transmission communities about the “5 micron cutoff” where droplets supposedly fall to ground w/in 1-2 m. [@jlc Colorado](#) and [@linseymarr](#) has suggested ~50 microns.

Here’s some video evidence for that. 50 micron droplets wafting in lab...

Watch on Twitter

6:16 PM · Jul 15, 2020



[Read the full conversation on Twitter](#)



717



Reply



Share this Tweet

[Read 30 replies](#)

76/ We investigated the history of the 5 micron / 2 meters error in a previous paper led by [@linseymarr](#) and the extraordinary [@katierandall](#), with support from [@EThomasEwing](#), Lydia Bourouiba of [@MIT](#) and yours truly:

77/ I am getting slightly out of order. I'll explain the reason for the "5 micron particles fall within the meters of the person" enormous error later in the thread, once I have explained the background.

So we were talking about the work of William Wells on airborne infection.

78/ The Wellses suspected that tuberculosis and measles were airborne, but BOTH were already believed to be droplet diseases, and they encountered intense resistance from the epidemiological community.

79/ Measles was thought to be a droplet/fomite disease. At the time of Wells... and as late as 1985, because of:

- ease of transmission in close proximity (= sprayborne droplets per Chapin)
- cases of lack of infection w/ shared air

[pediatrics.aappublications.org/cgi/pmidlookup...](https://pediatrics.aappublications.org/cgi/pmidlookup...)

# Measles (1985)

75%.<sup>1</sup> Most public health authorities believe that the primary mode of transmission is by large respiratory droplets which remain suspended in air for short time intervals.<sup>2</sup> Successful transmission in this manner requires close contact between susceptible individuals and a source patient, usually within 1 m (3 ft). Data supporting respiratory droplet spread come from studies conducted in the early 20th century.<sup>3</sup> Following hospitalization of 182 patients with measles at two hospitals, only one secondary case of measles occurred. Transmission was limited despite free circulation of air in both hospitals, presumably because measures were taken to prevent direct contact between patients with measles and others who were susceptible.

80/ Wells thought that measles was airborne (and now we know he was correct, though he died 2 decades before this was accepted)

Wells has some initial success showing that UV lights installed in the ceiling of classrooms greatly reduced measles infection

[ajph.aphapublications.org/doi/10.2105/AJ...](http://ajph.aphapublications.org/doi/10.2105/AJ...)

# Germicidal UV Works

Dec., 1943

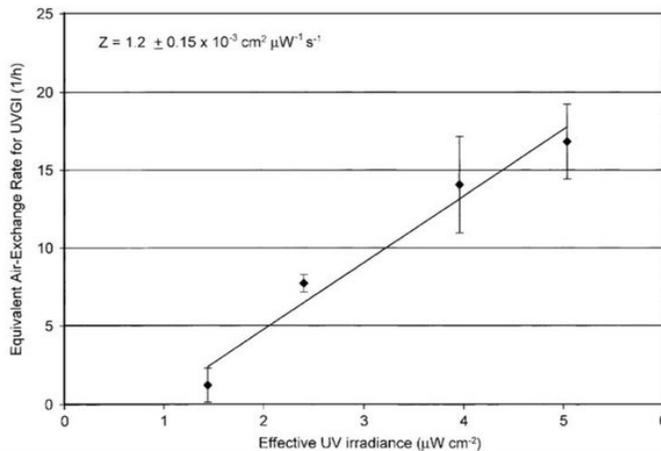
## Air Disinfection in Day Schools\*

W. F. WELLS

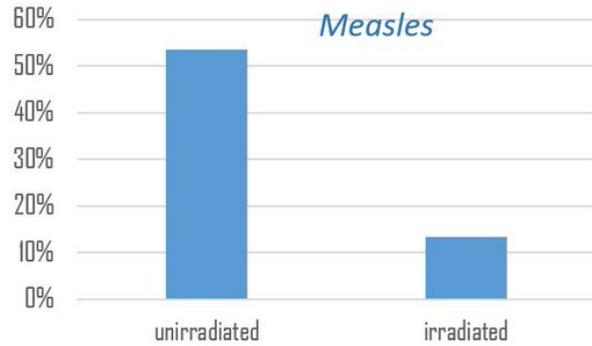
Associate Professor in Research in Air-borne Infection, Laboratories for the Study of Air-borne Infection,† Department of Preventive Medicine and Public Health, University of Pennsylvania School of Medicine, Philadelphia, Pa.



*The first sentence of this paper reads: "The prevalence of respiratory infection during the season of indoor congregation suggests a natural relationship between ventilation and communicable disease."*



### Susceptibles infected



- More expensive & complex
- More risks
- Do where needed, by professionals

Slide adapted from Prof. Shelly Miller

<https://ajph.aphapublications.org/doi/10.2105/AJPH.33.12.1436>

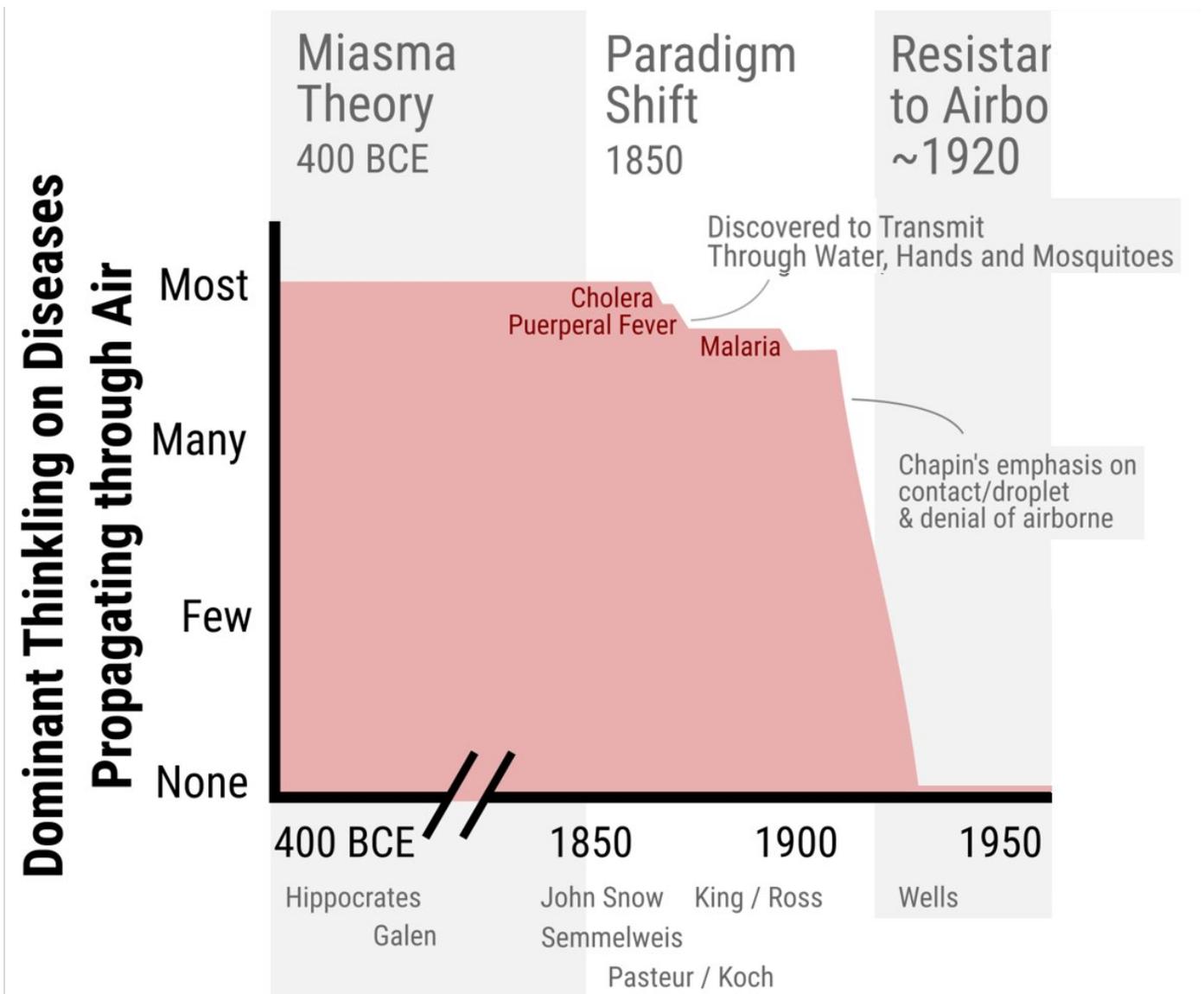
<https://www.sciencedirect.com/science/article/pii/S1352231002008257#FIG7>

81/ However, subsequent attempts to replicate these findings produced mixed results.

In retrospect, in schools where UV prevented measles transmission, children were together indoors only in the school, not elsewhere. In other schools, children shared other spaces (e.g. buses)

82/ Wells established the scientific basis of airborne infection

But he was working in a period of intense hostility in public health and inf. diseases towards airborne tr., ushered by the success of the 1910 paradigm shift of Chapin after 2 millenia of belief in miasmas



83/ General skepticism against airborne tr. is illustrated by 1951 quote of Langmuir (first and longtime director of epidemiology @CDCgov) :

"It remains to be proved that airborne infection is an important mode of spread of naturally occurring disease"

84/ Langmuir worked preventing disease trans. among US military in WW II

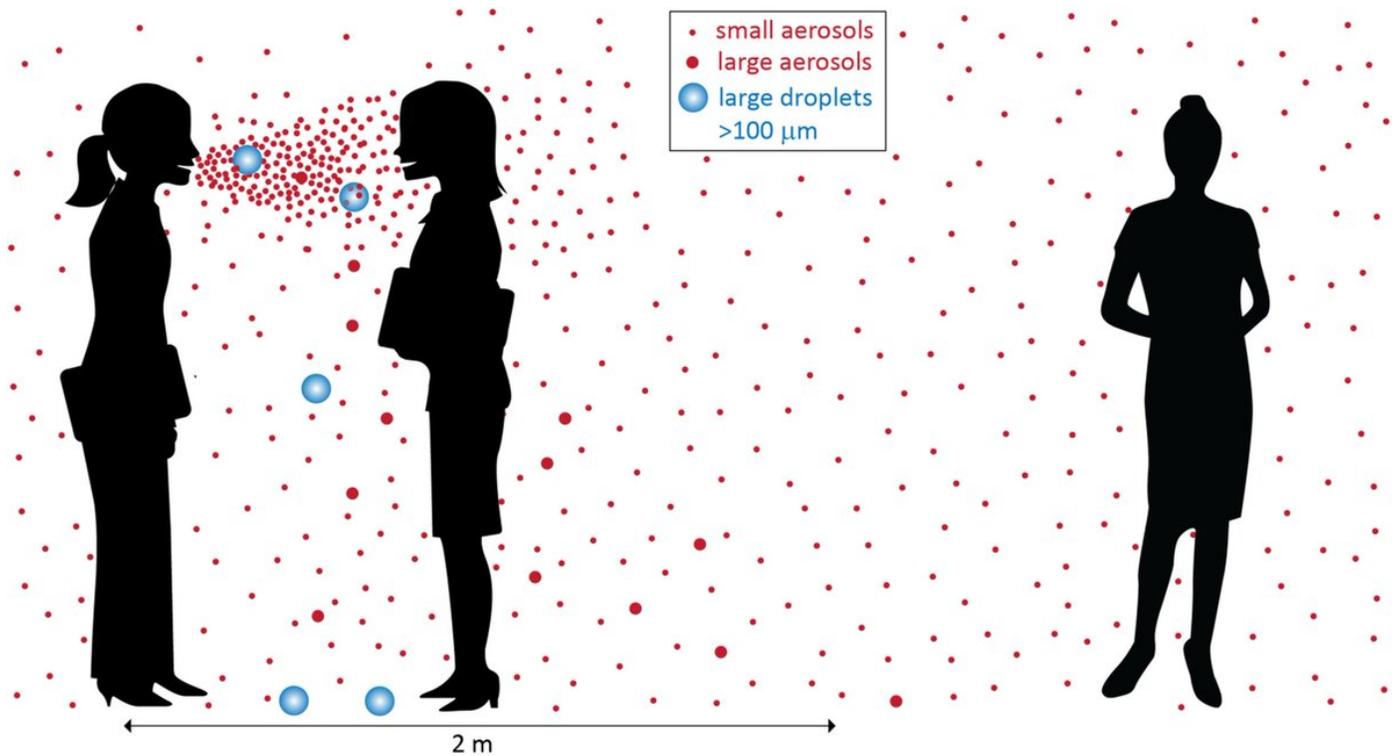
Substantial resources were dedicated to the effort, generating knowledge "which would have taken decades to accumulate under peacetime conditions" & established leaders for decades

85/ Langmuir et al. studied airborne transmission, but MISINTERPRETED the results of their own studies:

Distance reduced transmission, therefore it was droplets. Ignoring that distance reduces airborne transmission by dilution.

[doi.org/10.1093/aje/14...](https://doi.org/10.1093/aje/14...)

[doi.org/10.1111/ina.13...](https://doi.org/10.1111/ina.13...)



86/ However, Langmuir's work renewed interest in airborne infection, as he concluded that WEAPONS of airborne disease could be created, which became a topic of intense interest during the cold war.

87/ Despite stubborn resistance to the idea that airborne transmission had relevance for natural diseases, Wells, Robert Riley [pic] & Cretyl Mills succeeded in demonstrating airborne transmission of tuberculosis (TB) in 1962 through extensive efforts

[doi.org/10.1164/arrd.1...](https://doi.org/10.1164/arrd.1...)



88/ They routed air from TB hospital ward to 150 guinea pigs (GP) for 2 yrs.  
~3 GP / month were infected

No GP infected in control group where the only difference was that the air was irradiated with germicidal ultraviolet light, killing the TB bacterium

[doi.org/10.1164/ajrccm...](https://doi.org/10.1164/ajrccm...)

# Wells, Riley & Mills

- Brings modern methods to airborne transmission
- Chapin theories reign
  - Wells accused of “trying to bring back miasmas”
- Works on measles & TB
  - Undeniable proof of airborne trans. of TB in 1962

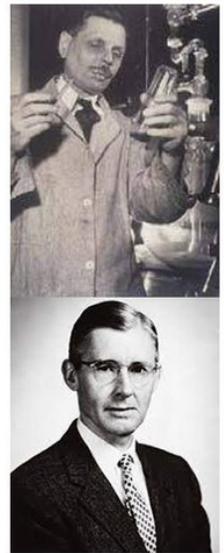


Image from prez. of W. Nardell, Harvard Univ.

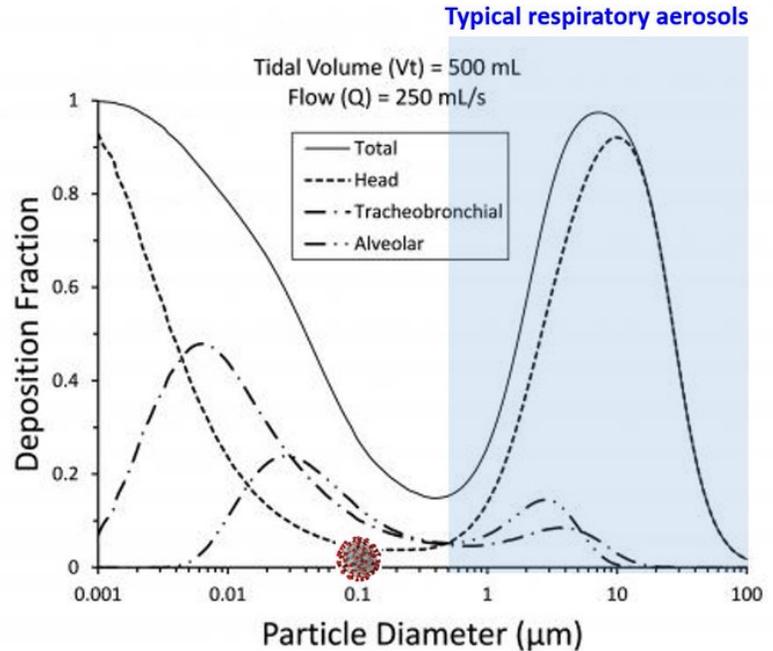
89/ Because of this, TB was the first important natural disease to be accepted as airborne in modern times

It was shown that pulmonary TB can ONLY infect if bacterium-containing aerosols reach the alveoli, for which they need to be smaller than 5 microns

[epa.gov/pmcourse/parti...](http://epa.gov/pmcourse/parti...)

# Aerosol Deposition in Resp. Tract

- Studied extensively for cold war biowarfare, pollution, occupational health, tobacco smoke, drug delivery to the lungs etc.
- Only aerosols  $< 100 \mu\text{m}$  can be inhaled
  - If it can be inhaled, it can reach  $> 1 \text{ m}$  beyond a person!
- Only aerosols  $\sim < 5 \mu\text{m}$  can reach deep lung
  - E.g. tuberculosis
- But most aerosols at  $5 \mu\text{m}$  deposited in head region



<https://www.epa.gov/pmcourse/particle-pollution-exposure>

90/ Here is when we think that the ERROR of "5 micron particles fall to the ground in 1-2 m" originated:

Only TB and bioweapons were important, someone at [@CDCgov](#) confused the size that goes to alveoli with size that falls to ground

Repeated till 2020

91/ The fascinating story of how [@katierandall](#), [@linseymarr](#) et al. figured out the cause of the 5 micron error was told in this article in [@WIRED](#) by [@MeganMolteni](#).

Reads like a spy novel, one of the best of the pandemic!

92/ In paper we characterize the years after the demonstration of TB as "Reluctant acceptance of as little airborne transmission as possible (1962–2020)"

Airborne disease was not impossible, but required an extremely high (undeniable) standard of proof.

93/ Unfortunately, standards of evidence were v. different for different routes of trans.

Many diseases accepted as "droplet" w/o any substantive proof—let alone extensive and time-consuming experiments

Only the hypothesis of Chapin, ease of infection in close prox. = droplets

94/ Remember, large droplet transmission has NEVER been demonstrated DIRECTLY for ANY disease in the entire history of medicine

[Paper from Prof. Yuguo Li, lone airborne specialist in [@WHO](#) IPC Committee]

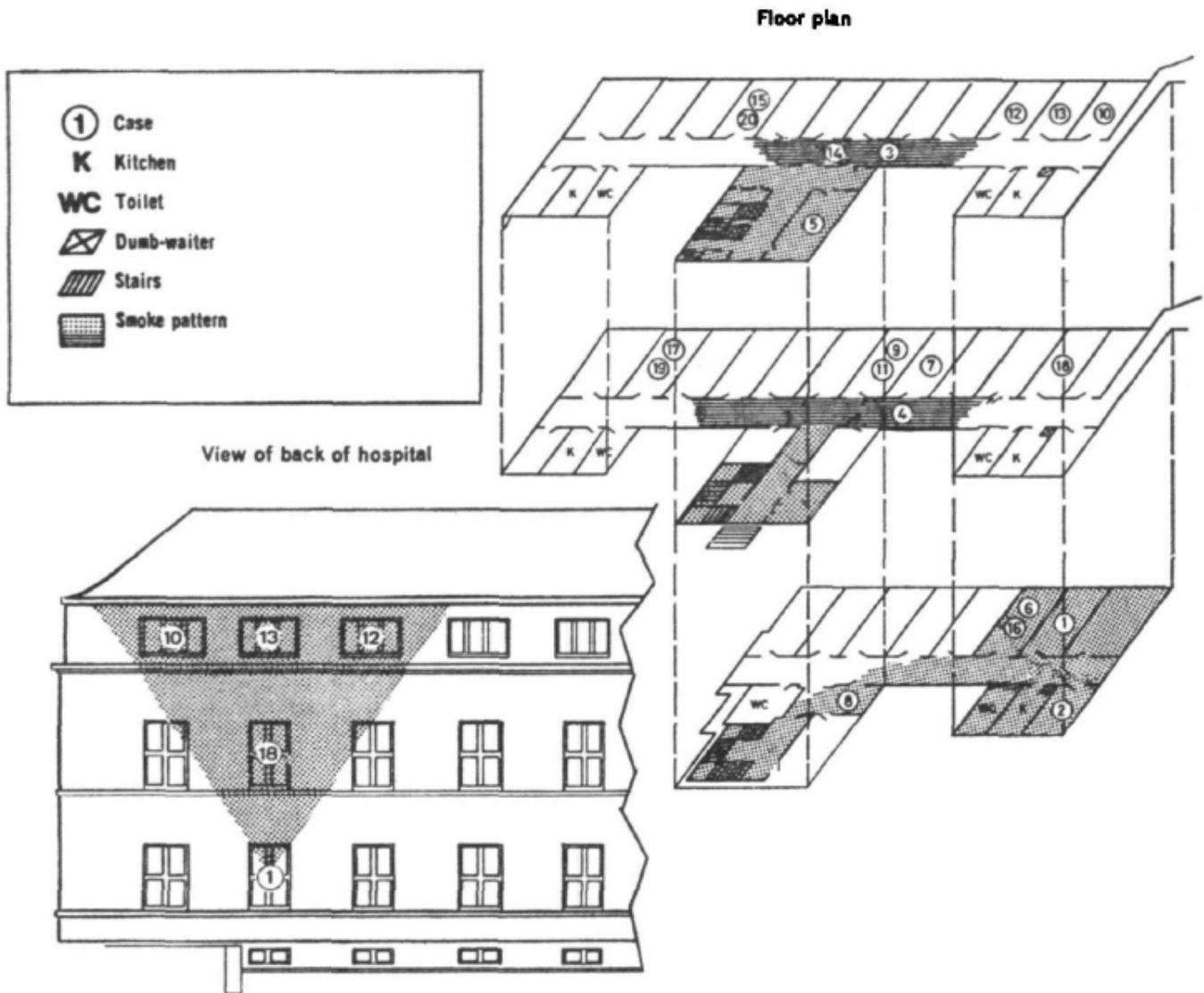
[sciencedirect.com/science/articl...](https://www.sciencedirect.com/science/article/...)

Reviewing the literature on large droplet transmission, one can find no direct evidence for large droplets as the route of transmission of any disease.

95/ An example of the resistance to airborne: an obvious case of long-distance airborne transmission of smallpox in Germany in 1970.

SP airborne trans. debated for centuries, only definitely accepted in the complete absence of community transmission

[pubmed.ncbi.nlm.nih.gov/5313258/](https://pubmed.ncbi.nlm.nih.gov/5313258/)



**FIGURE 2. Meschede Hospital**

96/ An infected person arrived from Pakistan to Germany, where there were no cases at all.

Only possible explanation was transmission through air. In latter tests, smoke from index case room went to rooms of secondary cases.

[academic.oup.com/aje/article-ab...](http://academic.oup.com/aje/article-ab...)  
[pubmed.ncbi.nlm.nih.gov/5313258/](http://pubmed.ncbi.nlm.nih.gov/5313258/)

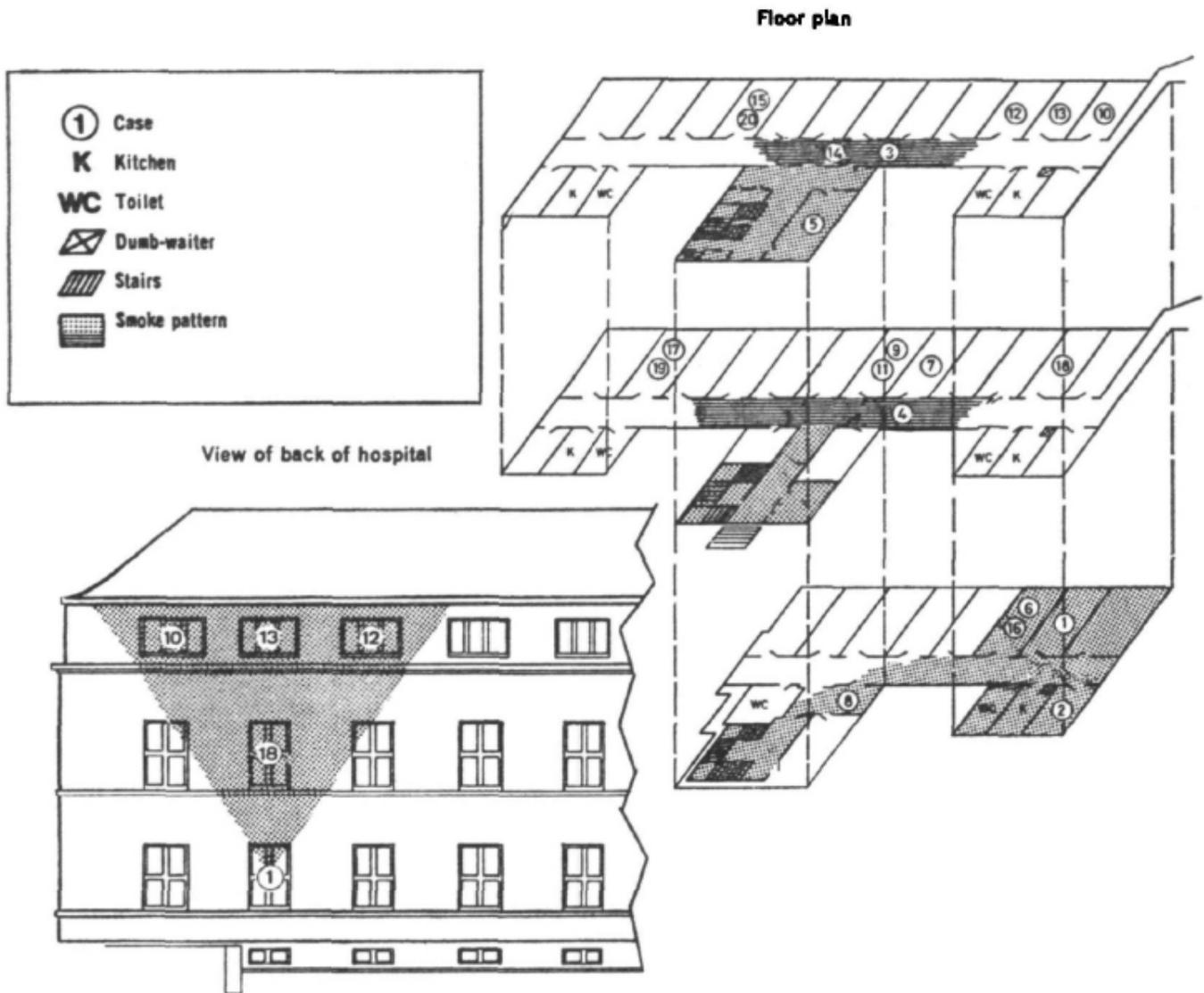


FIGURE 2. Meschede Hospital

97/ The case report shows the prevailing bias against airborne in Public Health:

“The only remaining route of transmission considered reasonable was airborne spread of a virus-containing aerosol, \*\*a possibility against which all of the investigators were initially prejudiced\*\*”

98/ Measles and chickenpox were similar, described as droplet diseases till mid-1980s, and only accepted when superspreading events with long-distance transmission made airborne undeniable.

[publications.aap.org/pediatrics/art...](https://publications.aap.org/pediatrics/art...)

[nejm.org/doi/full/10.10...](https://nejm.org/doi/full/10.10...)

**PEDIATRICS**<sup>®</sup>

Content ▾

Authors/Reviewers ▾

Collections ▾

Multimedia ▾

Blogs

Sul

**Volume 75, Issue 4**

April 1985



ARTICLES | APRIL 01 1985

## **Measles Outbreak in a Pediatric Practice: Airborne Transmission in an Office Setting** ✓

Alan B. Bloch; Walter A. Orenstein; William M. Ewing; William H. Spain; George F. Mallison; Kenneth L. Herrmann; Alan R. Hinman

*Pediatrics* (1985) 75 (4): 676-683.

<https://doi.org/10.1542/peds.75.4.676> **Article history** 🕒

99/ Interestingly the [@WHO](https://twitter.com/WHO) IPC committee members stated that COVID could not be airborne as it was much less transmissible than measles. Otherwise they would have recognized it quickly

Except... it took their profession 70 years to recognize it...

100/ Note that it is always the same error, going back to Chapin.

Assuming that ease of transmission in close proximity (and decreasing transmission w/ distance) is proof of large droplets, and that airborne is very unlikely.

For TB, measles, chickenpox... and COVID-19

101/ SARS-1 in 2003 brought renewed attention to airborne transmission

Superspreading was clearly observed. Airborne spread was implicated in several outbreaks in hospitals, and also in large Amoy Gardens outbreak in Hong Kong

[doi.org/10.3201/eid100...](https://doi.org/10.3201/eid100...)

102/ Same dynamic played out for SARS-1:

- observed ease of infection in close proximity was considered evidence of droplet transmission

- airborne transmission was considered unlikely, and only accepted if evidence was undeniable

From IPC member:

103/ During last several decades, until the COVID-19 pandemic, with available antibiotics, vaccines, and no major respiratory pandemics, studies further probing the details of droplet vs. airborne transmission had NOT been a major public health priority.

104/ High standards of ventilation & filtration in modern hospitals mean that airborne risks have been substantially mitigated in these settings, where many key infection control scientists work.

[cdc.gov/infectioncontr...](https://www.cdc.gov/infectioncontrol/)

[techstreet.com/ashrae/standar...](https://techstreet.com/ashrae/standards/)

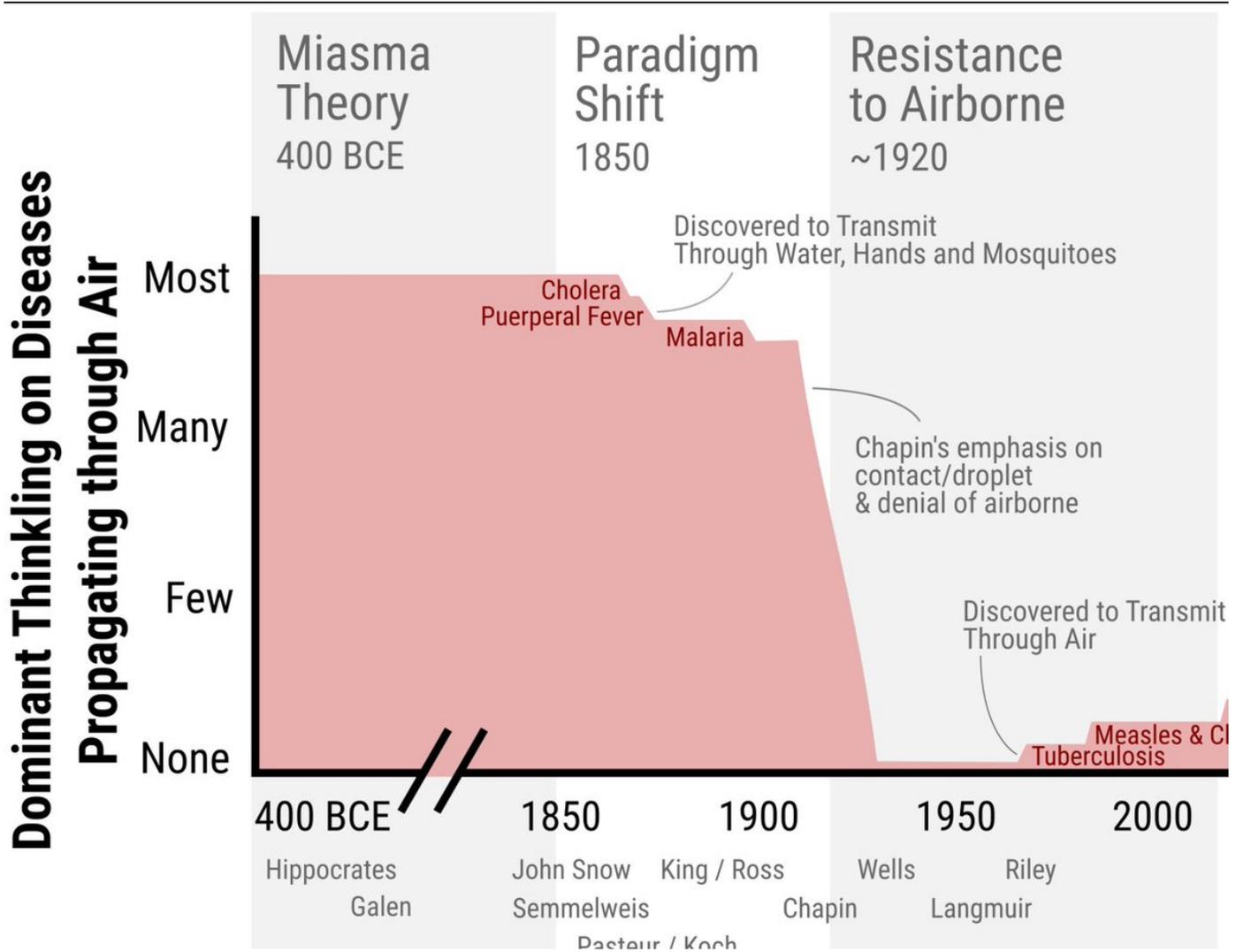
105/ Adherents of droplet transmission were in control of all key public health institutions.

Scientists proposing airborne transmission were typically ignored (as we saw later for COVID-19, and explaining persistence of errors)

[royalsocietypublishing.org/doi/10.1098/rs...](https://royalsocietypublishing.org/doi/10.1098/rsos.190200)

106/ This schematic qualitatively captures the situation before COVID-19 appeared:

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in.12111)



108/ Importantly, substantial scientific evidence had accumulated (BEFORE COVID) of airborne transmission of the flu, as reviewed in this paper in [@ScienceMagazine](#) (led by [@ChiaWang8](#) and [@kprather88](#)):

[science.org/doi/10.1126/sc...](https://science.org/doi/10.1126/sc...)

**Table 1. Airborne transmission of respiratory viruses.** Representative evidence of airborne transmission for various respiratory viruses and their basic reproduction number. Cells with dashes indicate not applicable.

Virus name	Scope of studies and/or approaches							Basic reproduction number ( $R_0$ )
	Air sampling and PCR	Air sampling and cell culture	Animal models	Laboratory or clinical studies	Epidemiological analysis	Simulation and modeling	Size-resolved information	
SARS-CoV	(31)	(31)	–	(30)	(30)	(30)	–	2.0–3.0 (197)
MERS-CoV	(32)	(32, 103)	(103, 198)	(32)	–	–	–	0.50–0.92 (197)
SARS-CoV-2	(41–44)	(34, 35, 40)	(33, 37, 199)	(34, 45, 107)	(36, 64, 71, 72, 186)	(36, 50)	(34, 41, 43)	1.4–8.9 (57, 58)
Influenza virus	(22, 23, 98, 102, 106)	(23, 98, 101)	(24, 137, 200, 201)	(24, 138, 202, 203)	(20)	(20, 114, 204)	(23, 105, 106)	1.0–21 (205)
Rhinovirus	(9, 27)	(26, 28)	–	(26–28)	–	(27)	(9)	1.2–2.7 (205)
Measles virus	(16)	(16)	–	–	(17)	(17)	(16)	12–18 (206)
Respiratory syncytial virus (RSV)	(102)	(25)	–	(25)	–	–	(25)	0.9–21.9 (205)

109/ But the evidence of airborne transmission of the flu had been ignored, and [@WHO](#) and [@CDCgov](#) pages on the flu ONLY mention droplets & surfaces

[who.int/news-room/fact...](https://www.who.int/news-room/fact-sheets/detail/influenza)

[cdc.gov/flu/about/dise...](https://www.cdc.gov/flu/about/diseases/)



## Influenza (Flu)

People with flu can spread it to others up to about 6 feet away. Most experts think that flu viruses spread mainly by droplets made when people with flu cough, sneeze or talk. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. Less often, a person might get flu by touching a surface or object that has flu virus on it and then touching their own mouth, nose, or possibly their eyes.



[Home](#) / [Newsroom](#) / [Fact sheets](#) / [Detail](#) / [Influenza \(Seasonal\)](#)

In terms of **transmission**, seasonal influenza spreads easily, with rapid transmission in crowded areas including schools and nursing homes. When an infected person coughs or sneezes, droplets containing viruses (infectious droplets) are dispersed into the air and can spread up to one meter, and infect persons in close proximity who breathe these droplets in. The virus can also be spread by hands contaminated with influenza viruses. To prevent transmission, people should cover their mouth and nose with a tissue when coughing, and wash their hands regularly.

309

[https://www.who.int/news-room/fact-sheets/detail/influenza-\(seasonal\)](https://www.who.int/news-room/fact-sheets/detail/influenza-(seasonal))  
<https://www.cdc.gov/flu/about/disease/spread.htm>

110/ Airborne transmission is well accepted in veterinary medicine, including several coronaviruses and flu viruses.

And sometimes over many kilometers (facilitated by large animal concentrations)

Every veterinary I've talked to is dismayed about COVID

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)

Furthermore, airborne transmission of viruses is well accepted in veterinary medicine including for some coronaviruses and influenza viruses, sometimes over distances of many kilometers. Examples include the foot and mouth virus,<sup>156, 157</sup> porcine reproductive and respiratory syndrome virus (PRRSV),<sup>158, 159</sup> porcine respiratory coronavirus,<sup>160</sup> avian infectious bronchitis virus (also a coronavirus),<sup>161</sup> and equine influenza.<sup>162, 163</sup>

111/ Finally we get to the COVID-19 pandemic. It is so massive and disruptive that every researcher that can contribute in some way gets to work doing so.

Includes lots of aerosol researchers (e.g. yours truly), with fast collaboration with medical researchers, virologists etc.

112/ Some early scientific and public health reports out of China state that COVID-19 has airborne transmission:

[doi.org/10.1038/s41586...](https://doi.org/10.1038/s41586...)

113/ Despite a lack of direct evidence in favor of droplet or fomite transmission of COVID, by Mar 2020 [@WHO](#) concluded that ease of transmission in close proximity proved that COVID-19 was transmitted by those mechanisms, continuing Chapin's 1910 error

World Health Organization (WHO) 

@WHO · [Follow](#)

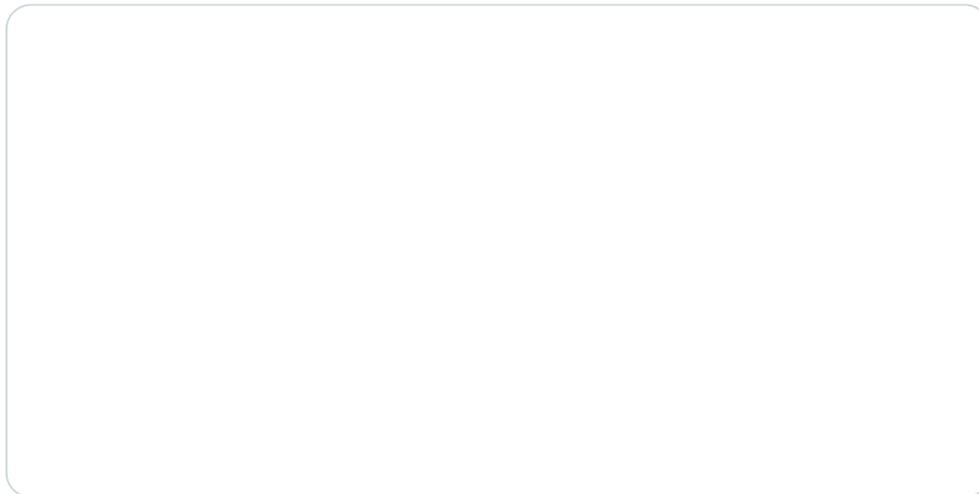


FACT: **#COVID19** is NOT airborne.

The **#coronavirus** is mainly transmitted through droplets generated when an infected person coughs, sneezes or speaks.

To protect yourself:

- keep 1m distance from others
- disinfect surfaces frequently
- wash/rub your 
- avoid touching your   



12:44 PM · Mar 28, 2020



[Read the full conversation on Twitter](#)



44.2K



[See the latest COVID-19 information on Twitter](#)

[Read 2.8K replies](#)

114/ The same errors described for other diseases are repeated for COVID-19. And the bar is moved higher: unlike TB, animal transmission is not enough. Unlike measles, superspreading and long-distance transmission is not enough...

However, and despite a lack of direct evidence in favor of droplet or fomite transmission, by March 2020 public health institutions like WHO concluded that ease of transmission in close proximity proved that COVID-19 was transmitted by those mechanisms,<sup>3</sup> continuing Chapin's 1910 error. Key experts from the WHO IPC committee implied that they would recognize an airborne disease given an expected high  $R_0$ ,<sup>32</sup> despite a delay of 70 years to recognize measles and chickenpox as airborne,<sup>86, 98</sup> and despite the fact that pulmonary tuberculosis is exclusively airborne and yet less contagious than COVID-19.<sup>164</sup> Interestingly, despite publications with the types of evidence that were sufficient for accepting tuberculosis (animal experiments<sup>165</sup>), and measles/chickenpox (superspreading and long-distance transmission, e.g. Ref.<sup>166-168</sup>) as airborne, WHO and other public health agencies continued to resist the importance of airborne transmission of COVID-19 for almost a year. The public health establishment remained entrenched in the old droplet paradigm. It considered the evidence of airborne transmission provided by the aerosol scientists, who were rebuffed and excluded from key committees, as weak or irrelevant.<sup>13, 31</sup> The same pattern discussed above, that is, minimizing the role of airborne transmission as much as possible, was on display, through the use of terms like "situational airborne," or by claiming airborne transmission is restricted only to poorly ventilated crowded locations. This is an error in logic, since all airborne pathogens are very sensitive to ventilation, e.g. Ref.<sup>169</sup> and if they can infect in shared room air, they must be much more infective in close proximity where they are much more concentrated (Figure 1).<sup>91</sup> Thus, if a pathogen is airborne in poorly ventilated locations, respirators should also be worn to protect from it in close proximity.

115/ However, accumulating evidence in favor of airborne, and critical LACK of evidence for droplets or surfaces tilts the balance

Airborne transmission is (reluctantly and slowly) accepted.

E.g. one summary of evidence for [#COVIDisAirborne](#):

Prof. Jose-Luis Jimenez 

@jljcolorado · [Follow](#)



## 1/ TEN SCIENTIFIC REASONS IN SUPPORT OF AIRBORNE TRANSMISSION OF SARS-CoV-2

Peer-reviewed publication in [@TheLancet](#)

An honor to have collaborated in multidisciplinary team across medicine, infectious diseases, epidemiology, aerosol science, sociology

	<p>thelancet.com Ten scientific reasons in support of airborn... Heneghan and colleagues' systematic review, funded by WHO, published in Marc...</p>
---	--

5:43 PM · Apr 17, 2021



[Read the full conversation on Twitter](#)



4.2K



See the latest COVID-19 information on Twitter

[Read 118 replies](#)

116/ [@WHO](#) commissioned some reviews on the modes of transmission of COVID-19. The one on airborne included no airborne experts, and has been rejected by the reviewers:

[f1000research.com/articles/10-23...](https://f1000research.com/articles/10-23...)

WHO commissioned in 2020 a series of systematic reviews on the transmission of SARS-CoV-2 to a specific group. WHO commissioned a systematic review on airborne transmission with no aerosol science input, despite the cross-disciplinary complexity of the topic. Airborne transmission was reviewed in a very narrow way, only considering one type of evidence, namely the detection of viable virus in air,<sup>180</sup> despite the fact that this has not been achieved for accepted airborne diseases such as tuberculosis, measles, and chickenpox.<sup>4, 181</sup> The many other types of evidence that support airborne transmission as predominant for SARS-CoV-2 and that led to acceptance of tuberculosis, measles, and chickenpox as airborne<sup>21, 86, 87, 93, 98</sup> were ignored in the review. As of this writing, the paper had not passed peer-review, and the public comments from other scientists remained unanswered. e.g. Ref.<sup>182</sup> A review was written for "close contact,"<sup>183, 184</sup> which appears to be a conceptual error since close contact is a measurement of distance\* and not a mechanism of transmission. No review has been posted summarizing the evidence supporting droplet transmission, despite WHO and key coauthors stating that it is the main mechanism of transmission.

116/ Shockingly, no review has appeared (to my knowledge) on the evidence in favor of large droplet transmission, despite [@WHO](#) being so sure for a long time that it was dominant.

117/ A [@WHO](#)-sponsored review has been written on "close contact transmission" == "close proximity".

But that is a measurement of distance, NOT a mechanism of transmission!

Still carrying the error of Chapin, confusing close proximity w/ spray droplets

118/ That [@WHO](#)-sponsored review on close prox. transmission has also NOT been accepted for publ., and remains in limbo after over a year

Even though THEY GET TO CHOOSE REVIEWERS!

Read the comments that we posted on both articles:

[f1000research.com/articles/10-280](https://f1000research.com/articles/10-280)

119/ "Aerosol-generating medical procedures" were the only accepted cause of airborne transmission for over a year (e.g. by [@WHO](#)).

They originated from low-quality research in SARS-1. Research has show that real AGPs are talking, singing...

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)

AGPs were the only circumstance in which WHO clearly accepted airborne transmission as of mid-2020.<sup>10</sup> However, multiple studies during the COVID-19 pandemic showed that patients produce more aerosols through simply breathing, talking, singing, and coughing than from many AGPs.<sup>185-189</sup> Although the initial precaution was probably warranted, the continued emphasis on AGPs as a much higher airborne transmission risk than from naturally produced aerosols was misguided, but had not been widely corrected as of this writing.

120/ [@WHO](#) has finally accepted airborne transmission, including the fact that transmission in close proximity includes short-range airborne transmission.

But only in Dec. 2021, after we pushed them a lot.



## Latest WHO update (23-Dec-2021)

The English version was updated on 23 December 2021.



### How does COVID-19 spread between people?

We know that the disease is caused by the SARS-CoV-2 virus, which spreads between people in several different ways.

- Current evidence suggests that the virus spreads mainly between people who are in close contact with each other, for example at a conversational distance. The virus can spread from an infected person's mouth or nose in small liquid particles when they cough, sneeze, speak, sing or breathe. Another person can then contract the virus when infectious particles that pass through the air are inhaled at short range (this is often called short-range aerosol or short-range airborne transmission) or if infectious particles come into direct contact with the eyes, nose, or mouth (droplet transmission).
- The virus can also spread in poorly ventilated and/or crowded indoor settings, where people tend to spend longer periods of time. This is because aerosols can remain suspended in the air or travel farther than conversational distance (this is often called long-range aerosol or long-range airborne transmission).

<https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-covid-19-how-is-it-transmitted>

121/ But both [@WHO](#) and [@CDCgov](#) communicate poorly about this, not explaining it to the public, and avoiding the word "airborne" (which is the clearest for the public) as much as they can

E.g. no mention of airborne COVID in [@WHO](#)'s extensive Twitter feed:  
122/ And especially no clear description of the control measures. As [@kprather88](#) keeps saying, it is totally doable to majorly reduce transmission, once we accept it and get serious about it.

But it is a really inconvenient truth for those in power...

Prof. Jose-Luis Jimenez 

@jjcolorado · [Follow](#)



Replying to @jjcolorado

9/ But before we go into the history, there are other reasons to review.

Most importantly, surface-droplet transmission is very CONVENIENT to those in power. And AIRBORNE trans. is an inconvenient truth (just like climate change, dealt with similarly)

[telegraph.co.uk/global-health/...](https://telegraph.co.uk/global-health/...)



10:44 AM · Aug 23, 2022



1.2K



Reply



Share this Tweet

[Read 5 replies](#)

123/ My pinned tweet has a good summary of those protection measures against transmission (also in many other sources such as [@CleanAirCrewOrg](#), or the [@CDCgov](#) web pages if you actually read them in detail):

Prof. Jose-Luis Jimenez 

@jjcolorado · [Follow](#)

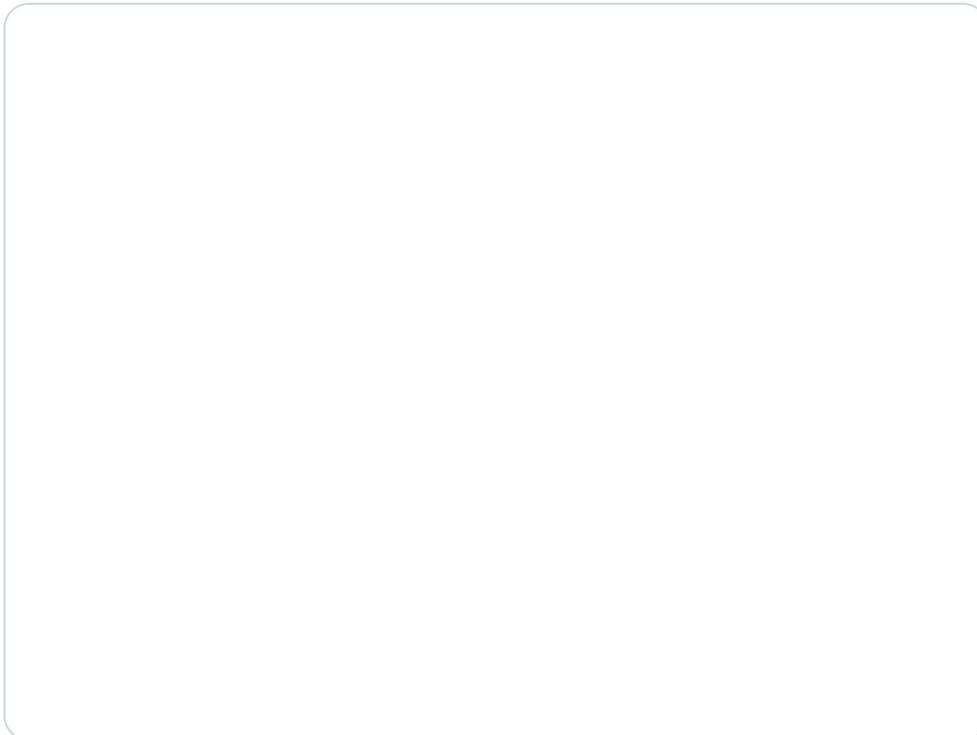


1/ HOW TO AVOID TRANSMISSION and have **#CleanAirHolidays?**

Most important: understand and explain clearly that we get infected by breathing infected air (aerosols) exhaled by SOME (not all) the infected

Mainly in close proximity, and in shared room air

**[journalofhospitalinfection.com/article/S0195-...](https://journalofhospitalinfection.com/article/S0195-...)**



10:39 AM · Nov 23, 2021



[Read the full conversation on Twitter](#)



6.1K



Reply



Share this Tweet

[Read 218 replies](#)

123/ So where does that leave us in mid-2022:

- PH institutions such as [@CDCgov](#) have given up on explaining or preventing transmission. Too inconvenient for those in power
- Scientifically, cat is out of bag. Tons of evidence of airborne, some medical & PH ppl understand it
- 124/ - Measures to improve ventilation are favored (e.g. by the [@WhiteHouse](#)) since they don't face resistance from public, but they are inconsistently applied.
- CO2 meters are resisted by institutions, because they make poor ventilation obvious.

[whitehouse.gov/ostp/news-upda...](https://www.whitehouse.gov/ostp/news-upda...)



## Let's Clear The Air On COVID

MARCH 23, 2022 • OSTP BLOG

*By Dr. Alondra Nelson, head of the White House Office of Science and  
Technology Policy and Deputy Assistant to the President*

The most common way COVID-19 is transmitted from one person to another is through tiny airborne particles of the virus hanging in indoor air for minutes or hours after an infected person has been there. While there are various strategies for avoiding breathing that air – from remote work to masking – we can and should talk more about how to make indoor environments safer by filtering or cleaning air.

<https://www.whitehouse.gov/ostp/news-updates/2022/03/23/lets-clear-the-air-on-covid/>

125/ Not sure how this will evolve. But as it becomes scientifically clearer, it will be harder to justify lack of action

But as we know from climate change (follow [twitter.com/i/lists/105306...](https://twitter.com/i/lists/105306...)), the sci. evidence can be overwhelming & those in power still resist inconvenient actions

126/ This is the final (hopeful) paragraph of this historical paper.

Wells lamented in 1945 the ignorance of airborne transmission in PH ([jstor.org/stable/18316#m...](https://www.jstor.org/stable/18316#m...))

Let's hope that ends with COVID-19 (& fight to make it reality - we need to

be activists)

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)

Thankfully, the intense research and debate associated with the COVID-19 pandemic have finally begun to generate a new paradigm shift in the understanding of disease transmission. Not only are respiratory diseases not transmitted exclusively by droplets, but also it is likely that many or most respiratory diseases have an important, if not predominant, airborne component of transmission.<sup>191</sup> It is also clearer that for a respiratory disease to have pandemic potential, airborne transmission is likely to be an essential component. This does not mark a return to past miasmatic ideas, but a more informed understanding of airborne transmission as more complex and less scary than in the past, and certainly as a tractable problem.<sup>33, 207, 208</sup> This new paradigm has major implications for the regulation and control of air quality in indoor spaces, by proper ventilation, filtration, and other means, as well as for PPE for workers and masking by the public. Finally, the lack of attention to the quality of shared indoor air that Wells lamented in 1945<sup>89</sup> may finally start to be remedied in the coming years,<sup>33</sup> potentially leading to a reduction in respiratory disease transmission for decades to come.

127/ I didn't do this alone. I got involved in COVID-19 transmission research in early 2020, and was shocked and confused by the stubborn and impatient resistance we faced.

E.g. Conly's (@WHO IPC Chair) rudeness on our Apr. 2020 call w/ @WHO]

[wired.com/story/the-teen...](https://wired.com/story/the-teen...)

On the video call, tensions rose. At one point, Lidia Morawska, a revered atmospheric physicist who had arranged the meeting, tried to explain how far infectious particles of different sizes could potentially travel. One of the WHO experts abruptly cut her off, telling her she was wrong, Marr recalls. His rudeness shocked her. “You just don’t argue with Lidia about physics,” she says.

128/ I've been lucky to work with the Morawska/@Don\_Milton group of 36 scientists & with many others

[@Don\\_Milton](#) made me curious about history, mentioning Chapin and his impact. I was perplexed an "ancient" researcher could influence [@WHO](#) advisors today so much. Started reading  
130/ Contributors to the paper include [@linseymarr](#) [@katierandall](#) [@EThomasEwing](#) [@zeynep](#) [@trishgreenhalgh](#) Raymond Tellier, Julian Tang, Yuguo Li, Lidia Morawska, [@jmcrookston](#) [@DFisman](#) [@Orla\\_Hegarty](#) Stephanie Dancer, Philo Bluysen, Giorgio Buonanno, [@Marcel\\_Loomans](#) [@WBahnfleth](#)...

131/ [Authors continued] [@pkubioaerosol](#) Chandra Shekhar [@WargockiPawel](#) Arsen Kritov Melikov and [@kprather88](#)

The authors contributed majorly to the paper. If there are any remaining mistakes, they are mine.

132/ As always, if you think that something is incorrect, or if you have a paper that contradicts (or further supports) anything I am saying here or in the paper, please send it my way

134/ Thanks to [@kprather88](#) this history paper has an illustrious reader on Dr. Fauci.

**Kimberly Prather, Ph.D.** 

[@kprather88](#) · [Follow](#)



Replying to [@jljcolorado](#)

I shared it with Dr. Fauci last night...he wrote back and thanked me for sending it and said he found the paper "very interesting". Thanks for leading the effort on this publication [@jljcolorado](#).

6:26 PM · Aug 23, 2022



128



Reply



Share this Tweet

[Read 2 replies](#)

135/ Someone asked about why we did not cover the understanding of transmission in East Asia.

We were curious about it, also in Eastern Europe during cold war, both seemed more favorable to airborne.

There is clearly material for many papers there (send me any you find)

136/ But in investigating the history, it seemed that the denial and resistance of [#COVIDisAirborne](#), led by [@WHO](#) and [@CDCgov](#), was rooted in Western science and the Chapin error. So we focused on that in this paper.

See this text on paper (Methods):

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)

We searched for the origins of the resistance to recognizing airborne transmission during the COVID-19 pandemic, especially by leading public health institutions like WHO, which appeared to be rooted in Western scientific tradition. We acknowledge that other nations had their own views about respiratory disease transmission throughout history, but we do not explore those in this article

137/ There is an important typo on tweet #122.

The [@WhiteHouse](#) document came out in Mar-2022, NOT 2020 as the slide erroneously showed (things could have been very different in that case! ALthough [@CDCgov](#) has just ignored this [@WhiteHouse](#) doc)

Thxto Lin & [@kprather88](#) for catch



## Let's Clear The Air On COVID

MARCH 23, 2022 • OSTP BLOG

*By Dr. Alondra Nelson, head of the White House Office of Science and  
Technology Policy and Deputy Assistant to the President*

The most common way COVID-19 is transmitted from one person to another is through tiny airborne particles of the virus hanging in indoor air for minutes or hours after an infected person has been there. While there are various strategies for avoiding breathing that air – from remote work to masking – we can and should talk more about how to make indoor environments safer by filtering or cleaning air.

<https://www.whitehouse.gov/ostp/news-updates/2022/03/23/lets-clear-the-air-on-covid/>

138/ When the American Thoracic Society is re-tweeting our work, I have hope that change may come

Change on airborne trans. will NOT happen (or REALLY slow) unless medicine / public health pushes

Thanks [@atscommunity!](#) [& Understood RT is NOT endorsement]



[twitter.com/jljcolorado/st...](https://twitter.com/jljcolorado/st...)

**Prof. Jose-Luis Jimenez**  @jljcolorado

1/ What were the historical reasons for the resistance to recognizing airborne transmission during the COVID-19 pandemic?

Our peer-reviewed open-access paper is now published:

[onlinelibrary.wiley.com/doi/10.1111/in...](https://onlinelibrary.wiley.com/doi/10.1111/in...)

1:00 PM · Aug 25, 2022



11



See the latest COVID-19 information on Twitter

[Explore what's happening on Twitter](#)

139/ BTW I forgot to thank [@numeroteca](#) for lots of help with the key figure on the paper (below)

And other Twitter users that helped me polish it online on this thread:

**Prof. Jose-Luis Jimenez** 

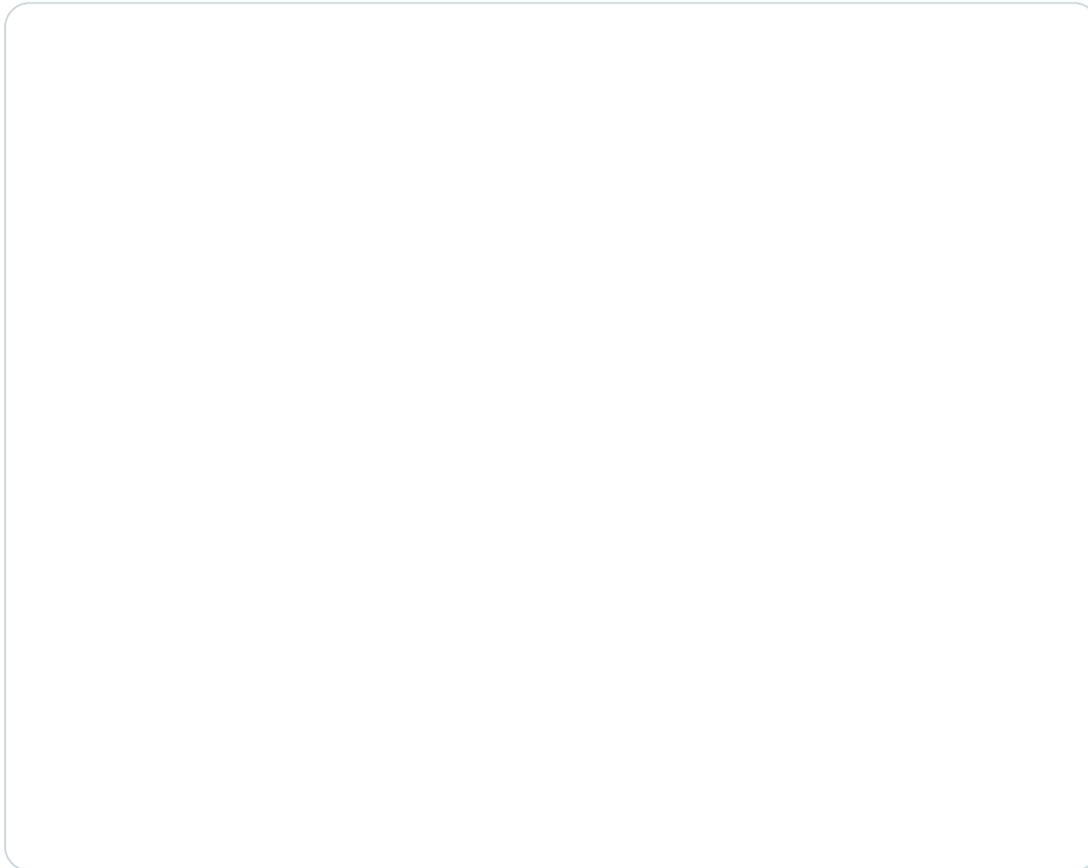
@jljcolorado · [Follow](#)



Replying to @jljcolorado

Thanks for the fast feedback. New version incorporating most of the feedback:

Q: does "trembling" line hurt? I thought ok in indicating not precise or rigid, lots of details not represented. But should I use straight segments?



11:51 AM · Jan 24, 2022



40



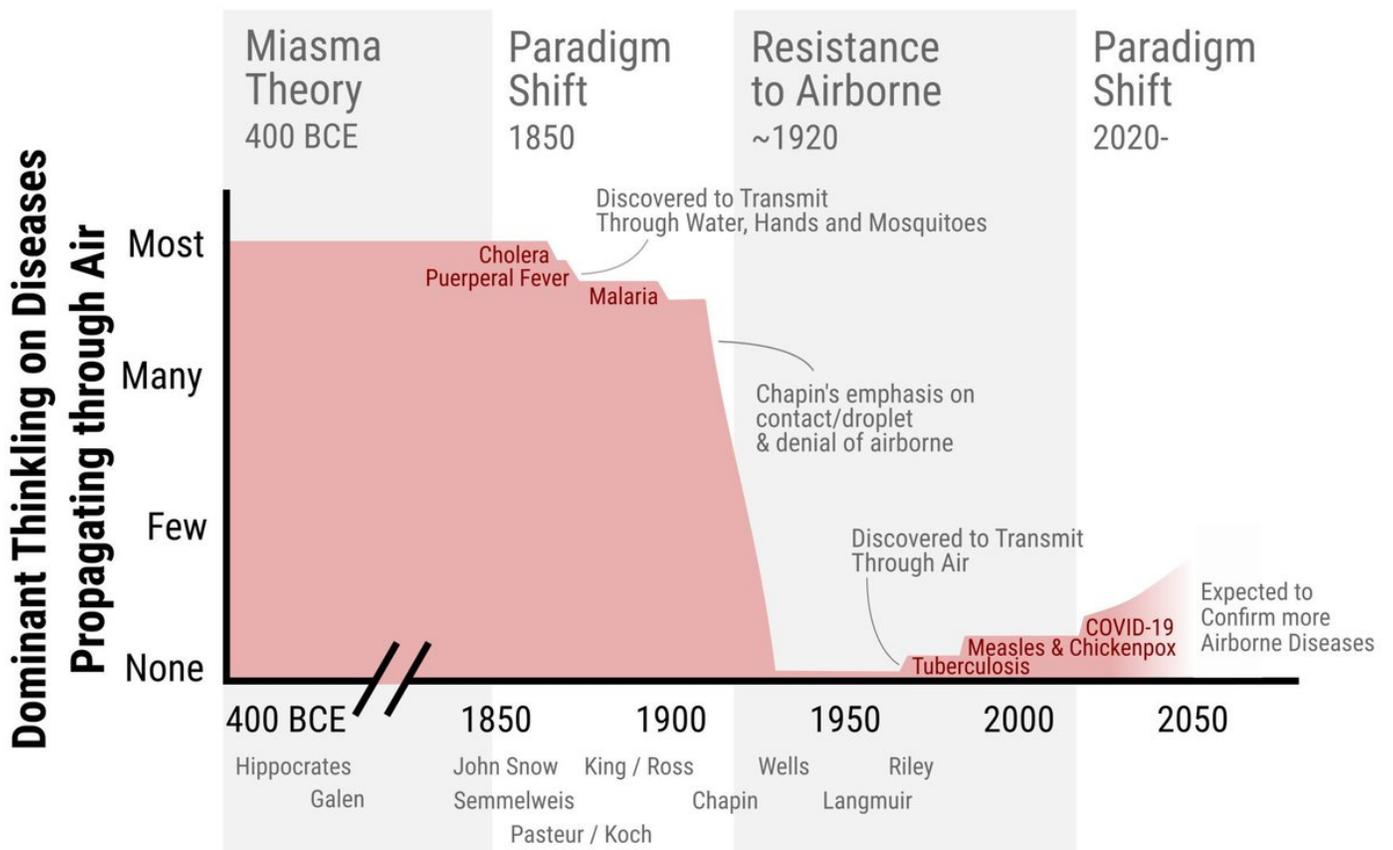
Reply



Share this Tweet

[Read 8 replies](#)

(& another I can't find)



...

Missing some Tweet in this thread? You can try to force a refresh