

2025: 20% doctor included?

an exercise in technology
speculation & musings

vinod khosla

vk@khoslaventures.com

@vkhosla

10% to 20% of cases:
delayed, missed, and incorrect diagnosis

graber, et al., jama

40,000+ patients in u.s. icus
may die with a misdiagnosis annually

winters, et al., bmj quality & safety

in many records of patients with a high-risk diagnosis,
high-information clinical findings were present
before the diagnosis was established

feldman, et al., jamia

nearly half of all american adults have difficulty
understanding and acting upon health information

institute of medicine of the national academies

most [patients] preferred
receiving their discharge information from the [computer] agent
compared to their doctors or nurses in the hospital

bickmore, et al., interacting with computers

50% of MDs are below-average

math

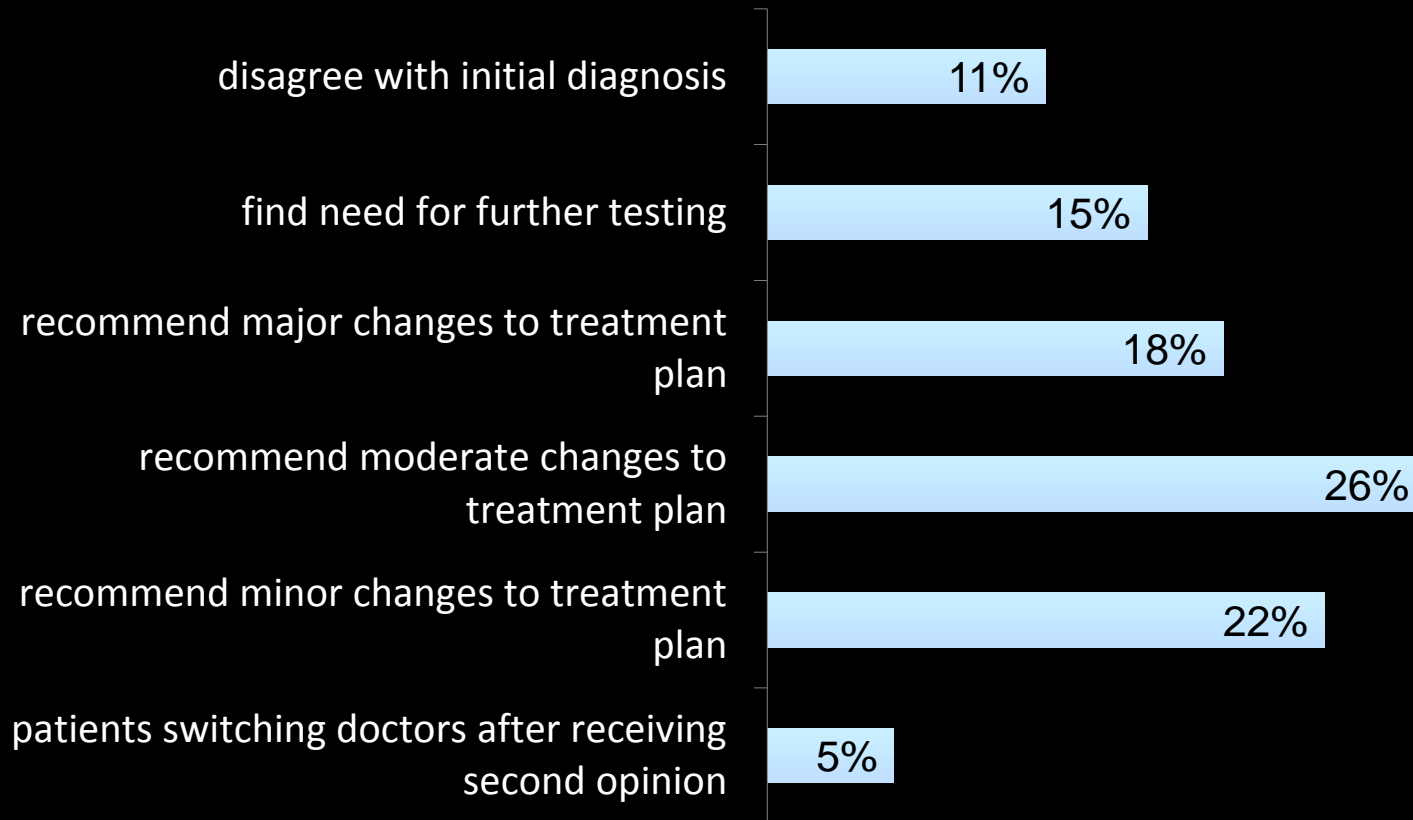
human doctors

cognitive limitations

cognitive biases

the value of second opinions

cleveland clinic doctors' review of initial diagnosis

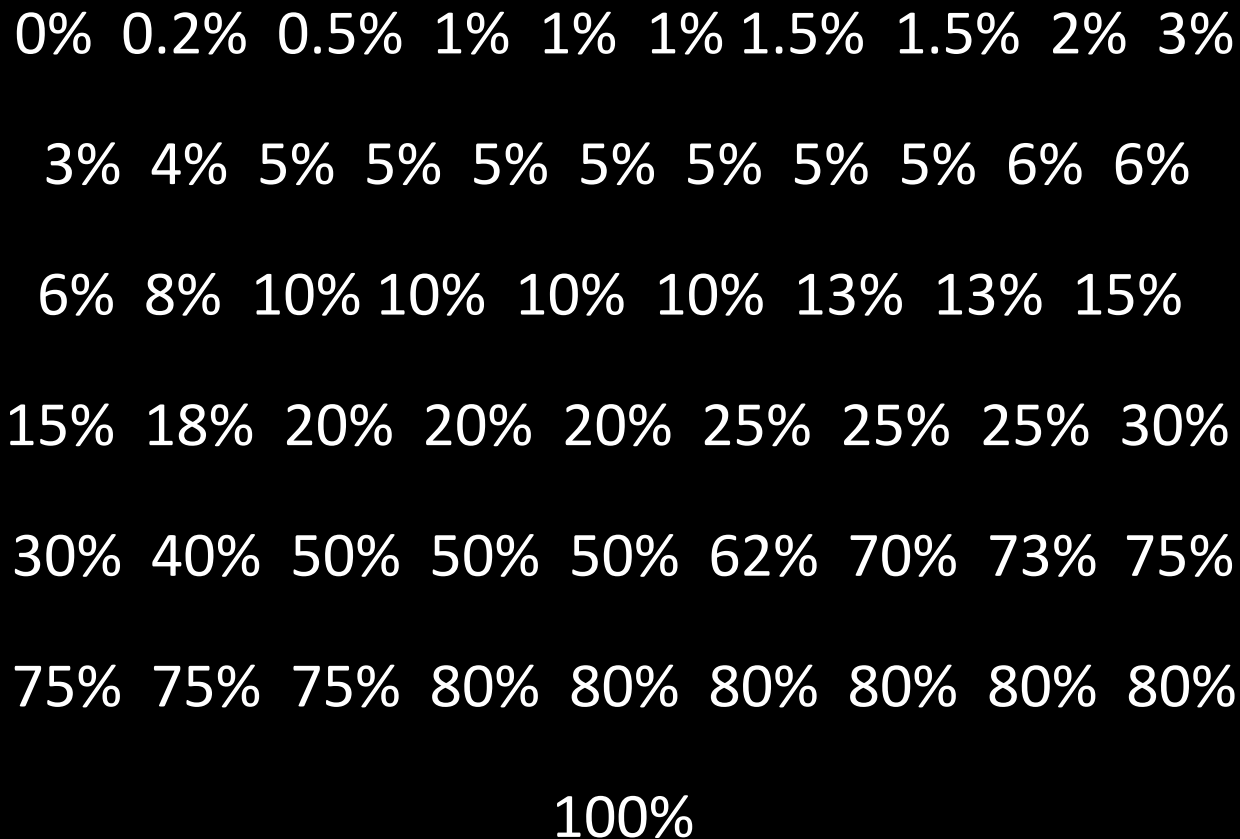


for most study designs and settings,
it is more likely for a research claim
to be false than true

john ioannidis

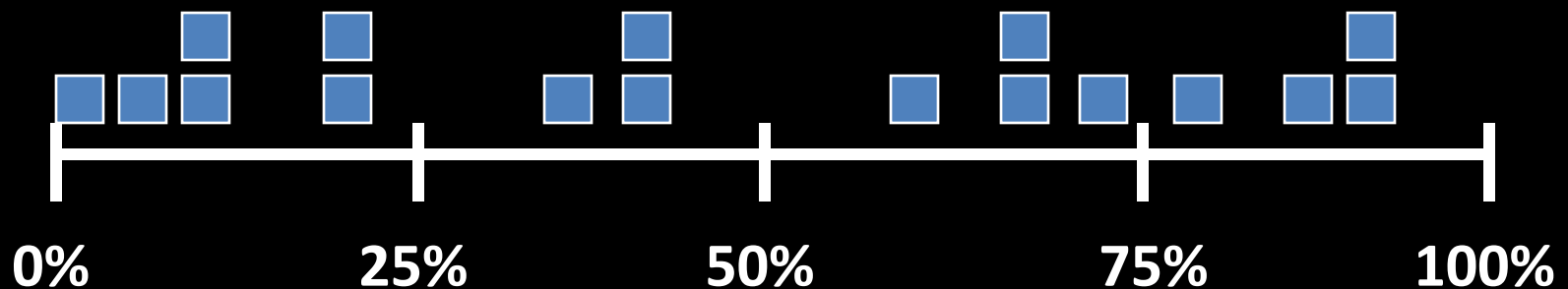
wide ranges of uncertainty

fifty-eight experts' estimates of the chance of a spontaneous rupture of a silicone breast implant



wide ranges of uncertainty

seventeen experts' estimates of
the effect of screening on colon cancer deaths



proportion of colon cancer deaths prevented

■ = one expert's response

entrepreneurs will ask
the naïve questions that uncover
hidden assumptions...

...and move us to
the grey zone of “speculations”

in the future,
you will have the data and the data analysis to become
the CEO of your own health

peter diamandis

80% of what MDs do can be replaced
(with better care than the average MD)...

...but not every MD function will be
replaced

lifecom CHAMP

I ...distributed care with medical assistants
were 91% accurate
without labs, imaging, or exams

II ...“safe triage” with 75% physician bypass
rate for acute care encounters

isabel II

matched expert diagnoses
95% of the time

archimedes

run clinical trials...

...before you run clinical trials

machines are better at integrative medicine...

...across “all symptoms”, demeanor, patient history,
phone activity, 1000s of data points, genomics,
population management guidelines, ...

...and machines won't have to win
every red state and blue state...

...they'll just be better overall

the “human” element of care can be
provided by the most “humane” humans

(and MDs can be humane)

the transition will start with
“toddler MDs” and digital first-aid kits



dr. algorithm

v0

don't
when

ZocDoc BETA [Log in](#) | [Create Account](#)
New York, NY | [Brooklyn, NY](#)

Doctor and Dentist Appointments. Instantly.

Search for a: in: **SEARCH**

(Optional) Your Insurance:

(Optional) More Search Options:

Appointment Date: Reason for Visit:

1. Find a Doctor


★★★★★
"Doctor was professional and friendly. Highly recommended!"
- NYCCAT99


Search by your insurance and location and read other patients' reviews.

2. Choose a Time

Thursday 01/22/2009	Friday 01/23/2009	Saturday 01/24/2009	Sunday 01/25/2009
10:00 am	10:00 am	10:30 am	
10:15 am	10:15 am	10:45 am	
10:30 am	10:30 am	11:00 am	
10:45 am	10:45 am	11:15 am	
11:00 am	11:00 am	11:30 am	
11:15 am	11:15 am	11:45 am	
11:30 am	11:30 am		
11:45 am	11:45 am		






Our Doctors guarantee that they'll see you at the time you've chosen.

3. See the Doctor



Get the care you need - when you need it.

What the press is saying:

Forbes Boost Your Business Winner!
ZocDoc wins the Forbes Boost Your Business contest. [Read more...](#)

Get online instantly
when it works for you

don't go to the hospital and
get connected
to a bunch of electrodes...



...take your own ecg
for less than a buck...
...and know you have heart disease
before you have an attack!

don't go to the optometrist...



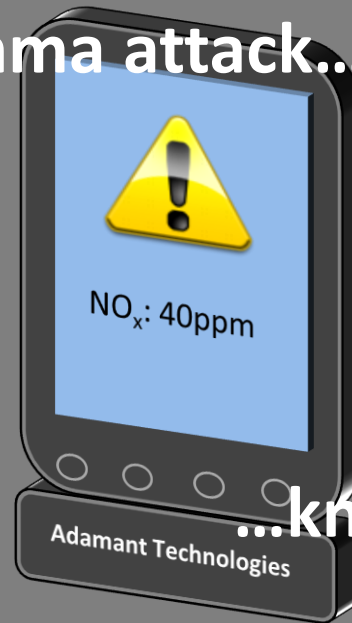
...get measured for glasses at home

don't wait days
to take your daughter to the
hospital...



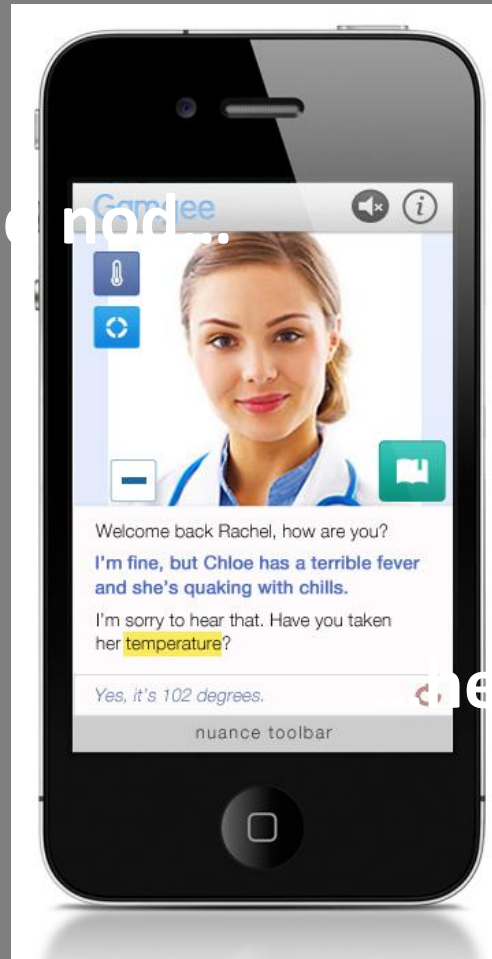
...check her ear infection
as soon as it hurts

don't wait for an asthma attack...



...know when it's coming

don't just smile and nod...



hear what your “doc”
is telling you

forget kappas of 0.2 in the DSM-5...



calling



texting



location



accelerometer

get reliable, consistent diagnoses

ALL DATA IS COLLECTED PASSIVELY
(* AFTER OPT-IN)

keep people out of the doctor's office...

...with point innovations in cardiology,
dermatology, optometry, psychiatry,
internal medicine, ...

healthcare service stations
&
digital first aid kits

...and your innovation here (call us)

innocuous point innovations...

...will become a wave...

...and grow into a tsunami

dr. algorithm

v0

v1 – 2015

v2 – 2017

v3 – 2019

v4 – 2021

v5 – 2023

v6 – 2025

...



we'll start with clumsy point innovations
like alivecor, cellscope, adamant, ginger.io,
neurotrek, consumer physics, jawbone,
misfit, ...

...“insighted” by Ayasdi...

...leading us to discover things we never
knew were right in front of us

the best MDs will train systems
over 10 years...

...systems will symbiotically provide
“bionic assist” and “AMPLIFY” MDs

dr. house+++ will be
the trainer for dr. algorithm

...no manners required!
...but manners learned!

findings thanks to data



using statins for in-hospital stroke patients
reduced the death rate by 40%!

better data for post-study studies

overcome ioannidis' problem of
regressions to the mean

**smart computers can be
objective cost minimizers...**

...while being care optimizers

the **practice** of medicine



the **science** of medicine

the problem is not MDs...

...they have served us well in the
“practice of medicine”...

...but humans are not good at the
integrative “science of medicine”...

...or the misalignment of incentives

there aren't enough rural doctors in india and
few have access to jama journals, mris, ...

...the world of medicine
is under-resourced globally

the shift to “computerization” has already
happened in other areas...

...airline pilots, stock trading, car driving

I will be wrong on the specifics but
directionally right...

...in the next decade, data science may
impact medicine more than biology

20% doctor included?

vinod khosla

vk@khoslaventures.com

@vkhosla