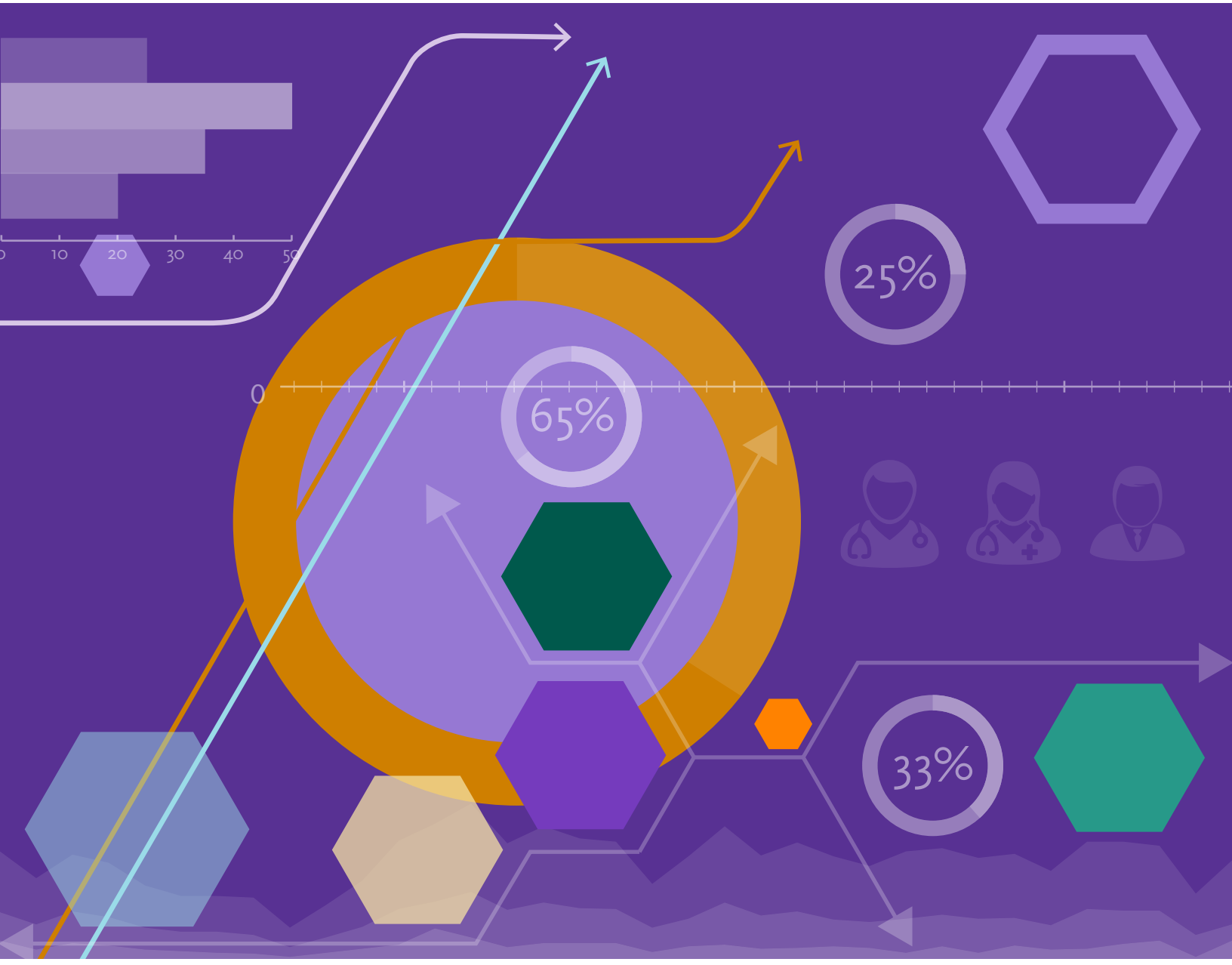
NEJM Catalyst | Innovations in Care Delivery

INSIGHTS REPORT — JANUARY 2020

Adoption of Artificial Intelligence and Machine Learning Is Increasing, but Irrational Exuberance Remains

Ziad Obermeyer, MD, MPhil, University of California, Berkeley
James Weinstein, DO, MS, Microsoft Healthcare



Adoption of Artificial Intelligence and Machine Learning Is Increasing, but Irrational Exuberance Remains

Ziad Obermeyer, MD, MPhil, Associate Professor (Acting), University of California, Berkeley

James N. Weinstein, DO, MS, Senior Vice President and Head of Innovation and Health Equity, Microsoft Healthcare

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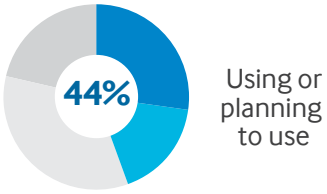
The use of artificial intelligence and machine learning (AI/ML) applications in health care has been marked by excitement at its nearly unlimited potential, as well as confusion over what these interrelated terms really mean. Has it passed from hype to real benefit?

Does your organization make use of artificial intelligence/machine learning applications?



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In a survey of NEJM Catalyst Insights Council members in August 2019, more than a quarter (27%) of respondents report that their organizations are currently using AI/ML applications, and they expect this number to rise to 44% within only two years. Promisingly, nearly half (47%) of those whose organizations currently use AI/ML say it has improved patient health. And a strong majority (85%) of total respondents say that clinician performance is more effective when augmented by AI/ML.

Ziad Obermeyer, MD, is Acting Associate Professor of Health Policy and Management at the University of California, Berkeley School of Public Health, where he does research on machine learning, medicine, and health policy. "I think for things such as clinical use cases for AI,

diagnosing cancer before it happens, and helping doctors diagnose heart attacks before they happen, we're still very, very early" in the maturity of AI, he says.

"On the other hand, I would be surprised if the respondents were off the mark on something like population health use. For example, if you look at a company like Optum, they have been incredibly successful at selling population health management tools to health care systems, as well as others, and some of them are machine learning tools. So I actually think on the clinical side, things are super early. But I think machine learning tools are actually very widespread in population health."

The survey results highlight some early adopters among the Insights Council and support the use of AI/ML for population health. The top three data types for which respondent organizations use AI/ML are clinical data (78%), population health data (43%), and operations data (37%).

The survey results also reveal a lot of uncertainty about the current state of AI/ML. Nearly a third (30%) of respondents say they don't know whether their organization's AI/ML solution has improved patient health. Half (51%) say that they are either not very confident or not at all confident in the accuracy of AI/ML clinical diagnoses and decision-making.

> *"I think there should be a huge 'caution light' on many of these reported possibilities for AI technology. We have yet to deliver on the outcomes that providers, payers, and patients are hoping for.*

James Weinstein, DO, MS, is Senior Vice President for Microsoft Healthcare, where he is Head of Innovation and Health Equity. He is also the former President and CEO of Dartmouth-Hitchcock Health. "Artificial intelligence efforts on clinical applications received a lot of attention for things like IBM Watson's work on cancer. This has led to some over-projecting of what AI can do," he says. "Thus, I think there should be a huge 'caution light' on many of these reported possibilities for AI technology. We have yet to deliver on the outcomes that providers, payers, and patients are hoping for."

Like Obermeyer, Weinstein points to pockets of successful early adoption. "There's a lot of AI occurring outside of the world of clinical operations and providers — for example, financial incentives for payers and pharma can be significant. The potential to speed up drug discovery is possible for pharma, while on the payer side, better claims adjudication, and management of denials."

Large data sets are a boost to AI/ML initiatives. UnitedHealth Group has "large numbers of patients for which they can build some pretty good AI models, even on various subpopulations. This is unique because they're able to use electronic health record data and claims data from a given health system supported by their own cadre of primary care providers," Weinstein says. "Much work remains, yet they're far ahead of other payers, hospitals, and clinics."

Survey respondents are bullish on the future impact of AI/ML, even in the near term. Two-thirds (66%) of respondents say that they expect care delivery to be impacted to some degree by AI/ML within two years. They expect clinical, population health, and operations data to be the top uses for AI/ML in two years (the same three data types at the top of the list today); and in addition, increased focus on patient genetics/genomics data (up 16 percentage points) and patient social determinants of health data (up 12 points).

While the use of AI/ML in purely clinical applications is still in the early stages, there has been a fair amount of hype about its potential. This has not necessarily been good for the industry's perception of its benefits, because not all AI/ML systems will be for activities such as curing cancer. This perhaps explains why some respondents appear to be caught in a dichotomy between irrational exuberance for its potential, and deep concerns about the accuracy of its clinical diagnoses and decision-making capabilities.

> *"There's a lot of AI occurring outside of the world of clinical operations and providers — for example, financial incentives for payers and pharma can be significant. The potential to speed up drug discovery is possible for pharma, while on the payer side, better claims adjudication, and management of denials.*

"If you look at the survey response closely, there a lot of people who are not at all confident about the accuracy for clinical purposes of these systems," says Obermeyer. "There are many people making aggressive claims about the accuracy of these systems, and I think providers and consumers are rightly picking up on the fact that some of that is hot air.

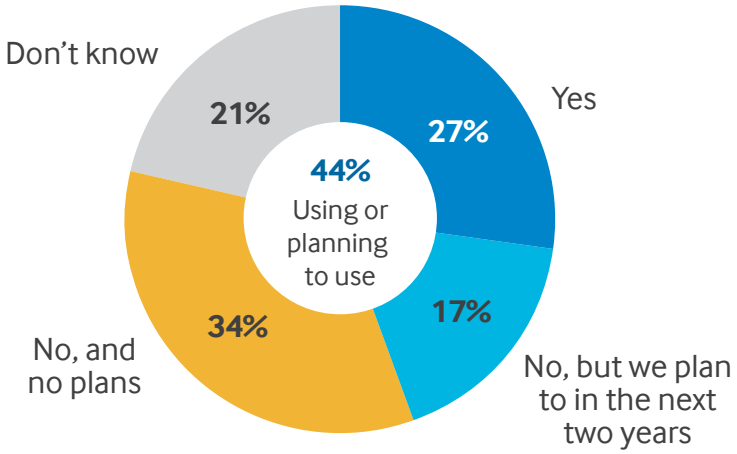
"My concern is that this can actually do some damage to the field of AI and machine learning, and may slow adoption. It has the potential to set us back several years when it turns out that not all of the emperors, but some of the emperors, are not wearing clothes."

Charts and Commentary

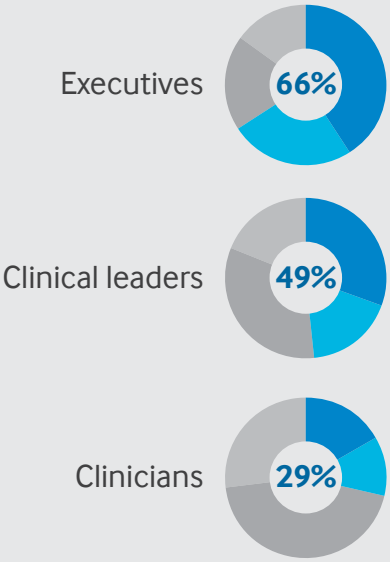
We surveyed members of the NEJM Catalyst Insights Council — who comprise health care executives, clinical leaders, and clinicians — about artificial intelligence and machine learning in health care. The survey explores the use of AI/ML applications at organization; hosting of AI/ML applications; types of data currently using AI/ML capabilities and within two years; improvement of patient health due to AI/ML initiatives; the future impact of care delivery due to AI/ML; the overall impact of AI/ML on the clinician workforce; benefits of AI/ML in health care; confidence in AI/ML systems' clinical diagnoses and decision-making accuracy; and the impact on clinician effectiveness when augmented by AI/ML. Completed surveys from 708 respondents are included in the analysis.

Limited but Growing Use of AI/ML Applications

Does your organization make use of artificial intelligence/machine learning applications?



A higher incidence of executives than clinical leaders and clinicians say their organization is currently using or planning to use artificial intelligence/machine learning applications.



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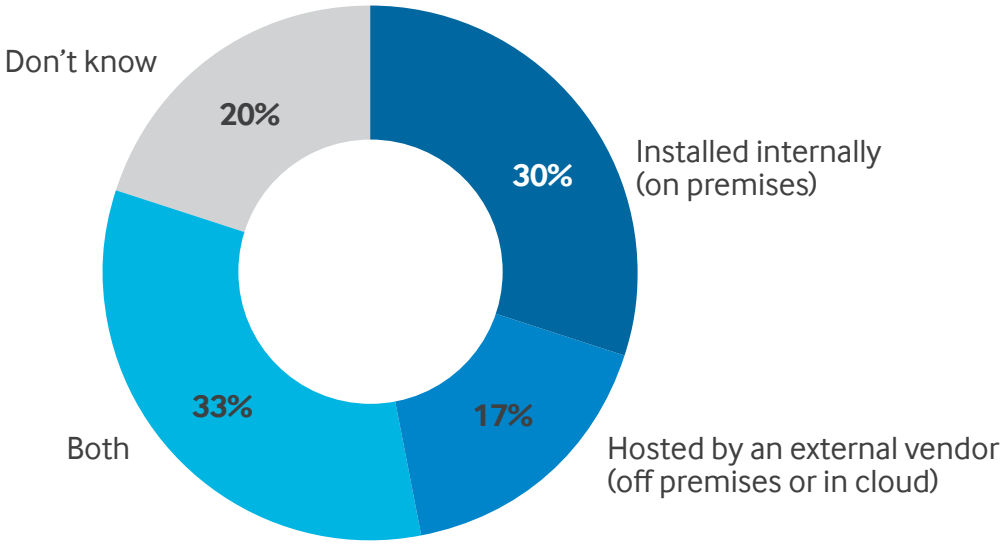
Nearly half of Insights Council members (44%) say that their organization either currently uses artificial intelligence/machine learning applications or plans to in the next two years. Far more executives (66% of those responding) than clinical leaders (49%) or clinicians (29%) say their organization is currently or planning to use AI/ML applications. But the single largest response is no use of AI/ML and no plans to do so. In a written response, one clinician says, "I live in rural America and do not know of AI/machine learning initiative."

Options for AI/ML Hosting

Where are your organization's artificial intelligence/machine learning applications hosted?



Base: 194 (Among those using AI/ML)

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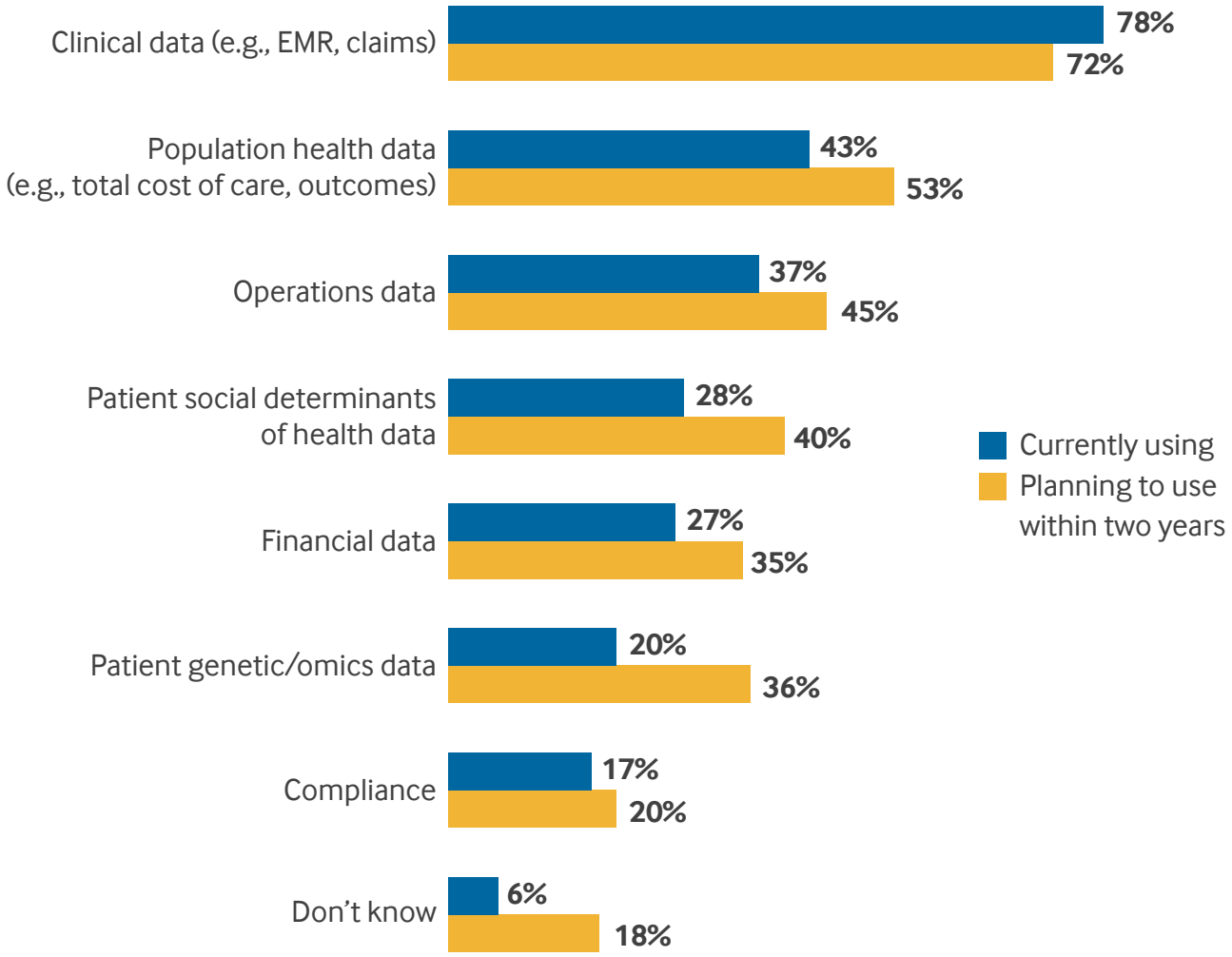
Survey respondents' organizations host their own AI/ML applications and put them on external clouds. A significantly higher incidence of executives (40%) than clinical leaders (24%) indicate their organization hosts AI/ML applications both internally and externally.

> *"There are many people making aggressive claims about the accuracy of these systems, and I think providers and consumers are rightly picking up on the fact that some of that is hot air.*

A Range of Data Uses for AI/ML, with Patient Data Increasing

On what types of data does your organization currently use artificial intelligence/machine learning capabilities?
On what types of data does your organization plan to use artificial intelligence/machine learning capabilities within two years?



Base: 194 (Among those using AI/ML) (multiple responses)

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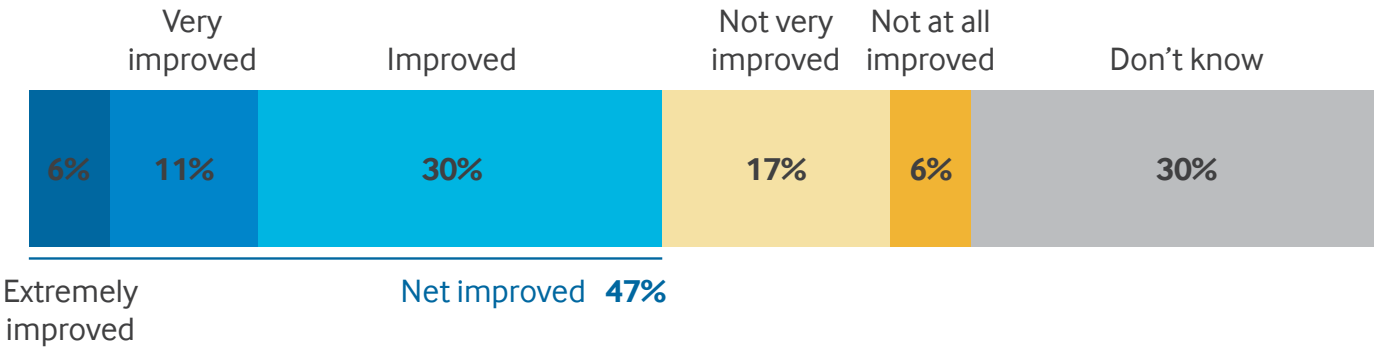
While Insights Council members indicate that the top three data types they use for AI/ML will remain the same over the next two years, they expect certain key data types to experience significant increases in usage. The greatest increases are for patient genetics/genomics data (up 16 percentage points), patient social determinants of health data (up 12 points), and population health data (up 10 points). Executives have higher response levels for clinical data (83%) than clinicians (76%) and clinical leaders (71%). One clinical leader says the most successful AI/ML initiative he knows of is "a reliable independent monitor of clinical performance, outcomes, and standardization of care."

AI/ML Is Improving Patient Health

As of today, how much has patient health at your organization been improved by artificial intelligence/machine learning initiatives?



Base: 194 (Among those using AI/ML)

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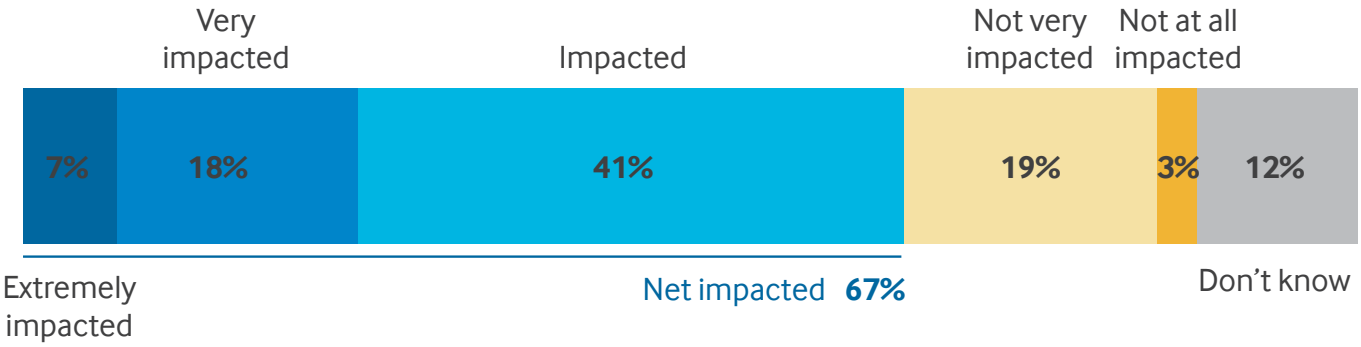
Nearly half of survey respondents say that AI/ML initiatives have improved patient health at their organizations to one degree or another. This view is consistent among executives, clinical leaders, and clinicians. One executive respondent specifies "operational flow, including timely efficient access to institutional services, efficiencies in procedural areas, and managing inpatient patient progression through the hospital admission to discharge."

> *"One clinical leader says the most successful AI/ML initiative he knows of is 'a reliable independent monitor of clinical performance, outcomes, and standardization of care.'*

Significant Impact on Care Delivery Expected from AI/ML

In two years' time, how much will care delivery be impacted by the use of artificial intelligence/ machine learning?



Base: 708 (Among those using AI/ML)

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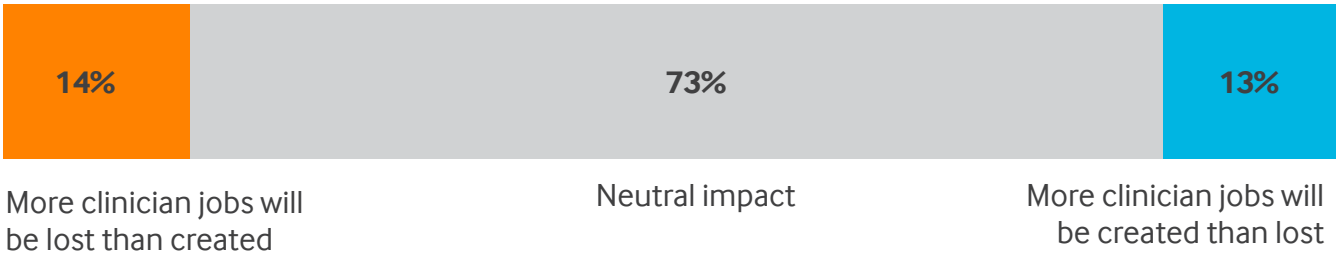
Two-thirds of Insights Council members expect AI/ML to have an impact on care delivery in two years' time. A higher percentage of executives (80%) than clinical leaders (69%) and clinicians (57%) expect an impact. One clinician writes, "Anticipated future success: We added an Artificial Intelligence Officer this year to our staff. Part of the role of this individual will be to develop digital tools and technologies that will leverage AI — leading to improvements in care for our patients." But another clinician cautions, "it is next to impossible to teach a machine ethics, empathy, and intuition."

> *"It is next to impossible to teach a machine ethics, empathy, and intuition.*

No Net Change in Clinician Workforce Expected from AI/ML

What overall impact do you expect artificial intelligence/machine learning will have on the size of the clinician workforce over the next two years?



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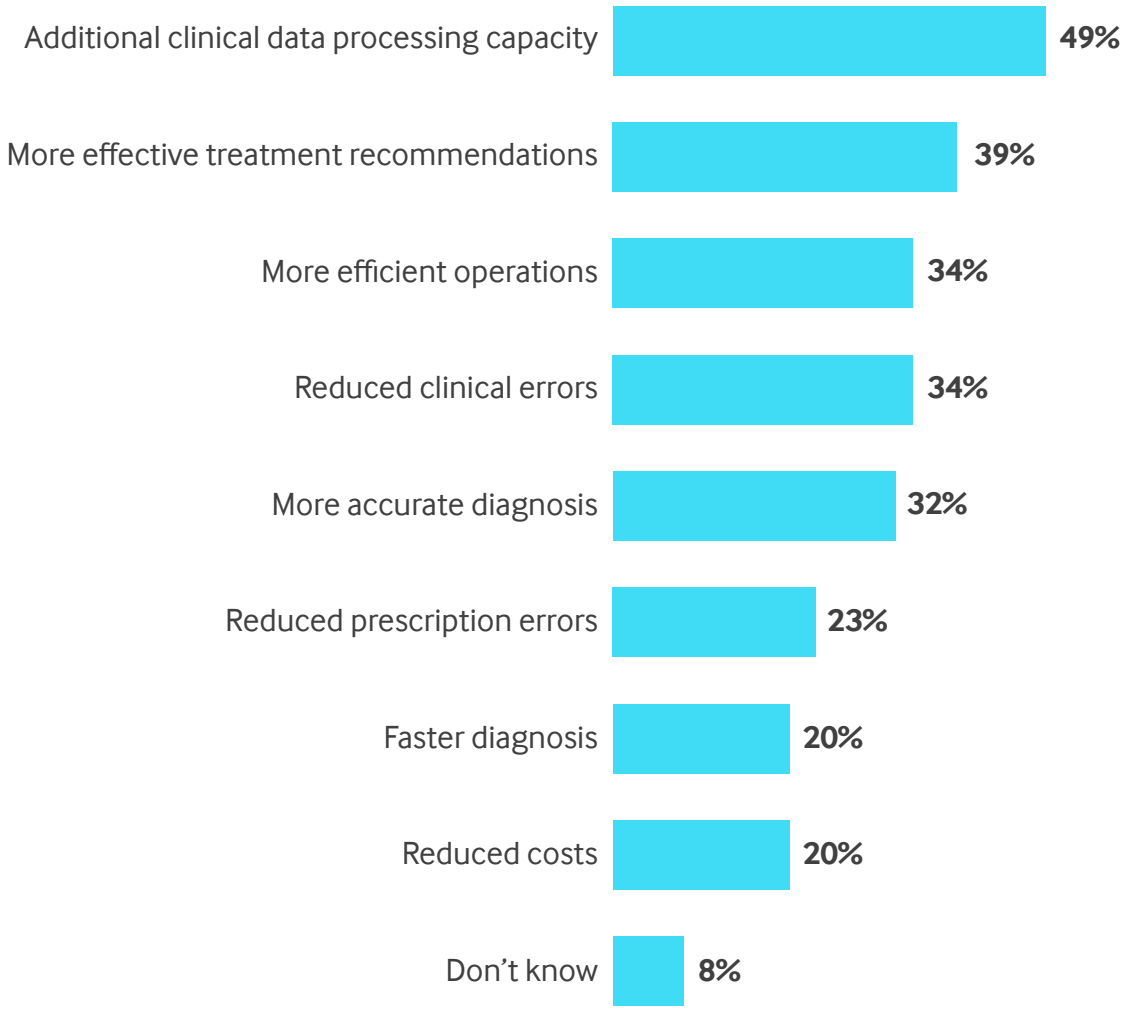
Respondents expect no net change in the size of the clinician workforce from AI/ML over the next two years. Some clinicians are experiencing anxiety on this point — a greater percentage of clinicians (19%) than clinical leaders (10%) and executives (10%) say that more clinician jobs will be lost than created.

> *"We added an Artificial Intelligence Officer this year to our staff. Part of the role of this individual will be to develop digital tools and technologies that will leverage AI — leading to improvements in care for our patients.*

Many Benefits from AI/ML in Health Care

What do you believe are the top three benefits of artificial intelligence/machine learning in health care?



Base: 708 (multiple responses)

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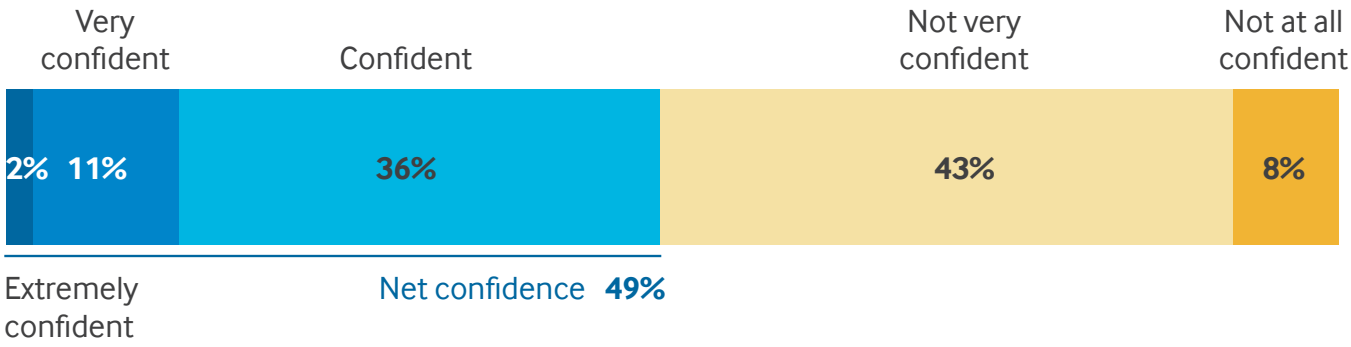
Survey respondents list a broad range of benefits from AI/ML applied to health care, centering on better clinical treatment and higher efficiency. Multiple respondents focused on the predictive capabilities of AI/ML, including of cardiac arrest, ED visits, sepsis, patient decline, readmissions, and population health. Others expressed concern about the disadvantages of AI/ML, such as "the art of medicine being lost in the process."

Split Views on the Accuracy of AI/ML Clinical Diagnoses and Decision-Making

How confident are you in the accuracy of current artificial intelligence and machine learning systems' clinical diagnoses and decision-making?



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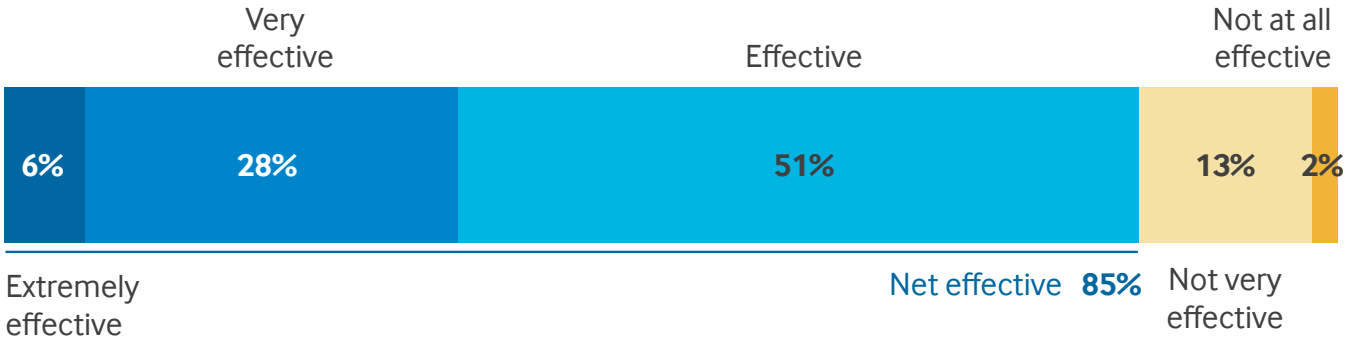
Insights Council respondents are evenly split in their confidence in the accuracy of AI/ML diagnoses and decision-making. A greater percentage of executives (57%) and clinical leaders (56%) have some level of confidence in its accuracy than clinicians (40%), following a consistent theme of clinician concern about AI/ML in this survey. A Chief Medical Officer from a community hospital in the South says, "It is very early days. Probably the most impact is in automating nonclinical processes. Supply chain. Purchasing. Claims. Second would be automating analytics. Even then understanding how to use the information is nascent. Great impact is expected from NLP and deep learning, but much work to do."

> *"Great impact is expected from NLP and deep learning, but much work to do.*

Clinician Performance Is Augmented by AI/ML

In general, how effective is clinician performance when augmented by artificial intelligence/machine learning?



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A strong majority of respondents say that clinician performance is more effective when augmented by AI/ML. But fewer clinicians (80%) than executives (93%) or clinical leaders (85%) agree.

> *"It is very early days. Probably the most impact is in automating nonclinical processes. Supply chain. Purchasing. Claims. Second would be automating analytics. Even then understanding how to use the information is nascent.*

Verbatim Comments from Survey Respondents

What is the most successful artificial intelligence/machine learning initiative you know of?

> *Radiology; differential diagnosis.*
>
> — Clinician at a small nonprofit health system in the Northeast

> *The most successful AI/ML initiatives so far that I know of have been the use of photographs for skin lesions and the prediction of sepsis.*
>
> — Department chair at a large nonprofit community hospital in the West

> *Studying outcomes data for large populations and applying this information to current treatment protocols and diagnoses.*
>
> — Director of a large nonprofit teaching hospital in the West

> *Image interpretation.*
>
> — Clinician at a midsized nonprofit government organization in the Midwest

> *IBM Watson and their patient preferences for cancer care.*
>
> — Chief Medical Officer at a large for-profit health plan in the South

> *I think this is a work in progress and very disease area–specific. There is high interest in this aspect from the pediatric pulmonary disease aspect in our center but I don't know how much is going on in other areas. It is promising in order to help with some level of standardization but will benefit by the human oversight since these are important decisions.*
>
> — Director of a large nonprofit teaching hospital in the West

> *Increased throughput of screening genomes for disease-causing mutations, especially for rare diseases; also, increased screening time for modeling potential new medications and targets.*
>
> — Clinician at a nonprofit teaching hospital in the Northeast

> *Laboratory interpretations.*
>
> — Department chair at a large nonprofit medical school program in the South

> *So far, our most successful AI/machine learning has been in the use of bots and AI in human resources as a screening tool for hiring.*
>
> — Executive at a large nonprofit teaching hospital in the South

> *Sepsis prediction.*

— Clinician at a small nonprofit teaching hospital in the Northeast

> *Natural language processing.*

— Service chief at a large nonprofit teaching hospital in the Northeast

> *Predictive tracking for at–risk patients.*

— Director at a midsized nonprofit health plan in the West

What is the least successful artificial intelligence/machine learning initiative you know of?

> *The early discussion of identifying primary care patients have a high likelihood of NOT showing up for appointments. I've heard discussions around this but the IT side has been very hesitant to try this. Plus there is a LOT of information that could help around this, like social determinants of health, that are NOT systematically collected or in any form that could be used w/ AI/ML.*

— Clinician at a midsized medical school program in the Midwest

> *I know nothing.*

— Chief Medical Officer at a small for-profit clinic in the South

> *I think AI has promise, but there has not been good documentation of real-world positive impact at this time. Educating clinicians on how to use this information is as important as having it.*

— Director at a large for-profit insurer in the Midwest

> *The big problem with AI is that it has not been adequately studied, the way a new drug or device would be. It is assumed that it will be a benefit because it is fancy new IT technology. The EMR disaster should have made us skeptical, but it did not. The AI parole systems have been an embarrassment, facial recognition has led to a number of false identifications, self-driving cars have killed pedestrians etc.*

— Clinician at a small nonprofit community hospital in the West

> *It's hard to say for sure, but Watson seems to have garnered the most hype for the longest period of time without having delivered any substantive results (at least from my perspective).*

— Service chief at a large nonprofit health system in the South

> *Prediction of clinical outcomes.*

— Vice President of a small nonprofit health system in the Northeast

> *The management of chronic diseases such as heart disease (coronary disease) and adult-onset diabetes do not lend themselves to AI when it comes to long-term stabilization. Here human intuition and decision making are, at present, superior to AI.*
>
> — Clinician at a small for-profit physician organization in the West

> *The lack of AI in EHR.*
>
> — Vice President of medical affairs at a small nonprofit teaching hospital in the West

> *I am not familiar with an actual initiative.*
>
> — Director of a midsized nonprofit community hospital in the South

> *None — even the EKG machine misreads basic EKGs!!!*
>
> — Clinician at a for-profit clinic in the South

> *Evaluation and management of chronic disease.*
>
> — Chief Medical Officer at a large for-profit health plan in the South

> *Primary care and fields like surgery requires patient interaction.*
>
> — Director at a small nonprofit health system in the South

Methodology

- The *Artificial Intelligence and Machine Learning in Health Care* survey was conducted by NEJM Catalyst, powered by the NEJM Catalyst Insights Council.
- The NEJM Catalyst Insights Council is a qualified group of U.S. executives, clinical leaders, and clinicians at organizations directly involved in health care delivery, who bring an expert perspective and set of experiences to the conversation about health care transformation. They are change agents who are both influential and knowledgeable.
- In August 2019, an online survey was sent to the NEJM Catalyst Insights Council.
- A total of 708 completed surveys are included in the analysis. The margin of error for a base of 708 is +/- 3.7% at the 95% confidence interval.

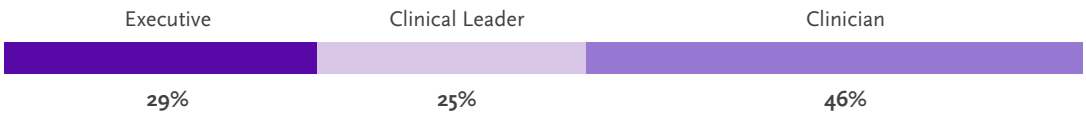
NEJM Catalyst Insights Council

We'd like to acknowledge the NEJM Catalyst Insights Council. Insights Council members participate in monthly surveys with specific topics on health care delivery. These results are published as NEJM Catalyst Insights Reports, such as this one, including summary findings, key takeaways from NEJM Catalyst leaders, expert analysis, and commentary.

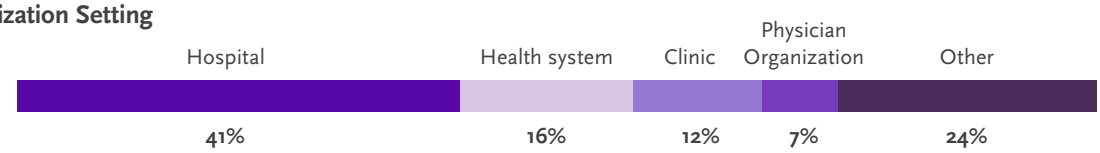
It is through the Insights Council's participation and commitment to the transformation of health care delivery that we are able to provide actionable data that can help move the industry forward. To join your peers in the conversation, visit join.catalyst.nejm.org/insights-council.

Respondent Profile

Audience Segment

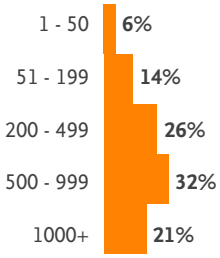


Organization Setting

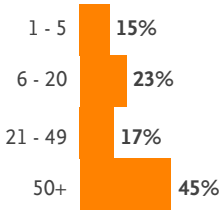


Type of Organization

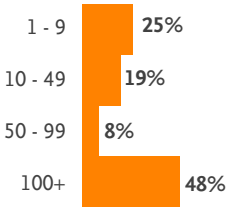
Number of Beds
(Among hospitals)



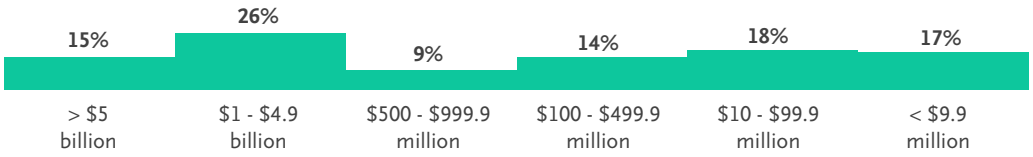
Number of Sites
(Among health systems)



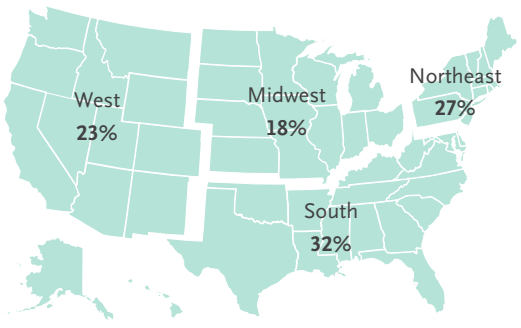
Number of Physicians
(Among physician organizations)



Net Patient Revenue



Region



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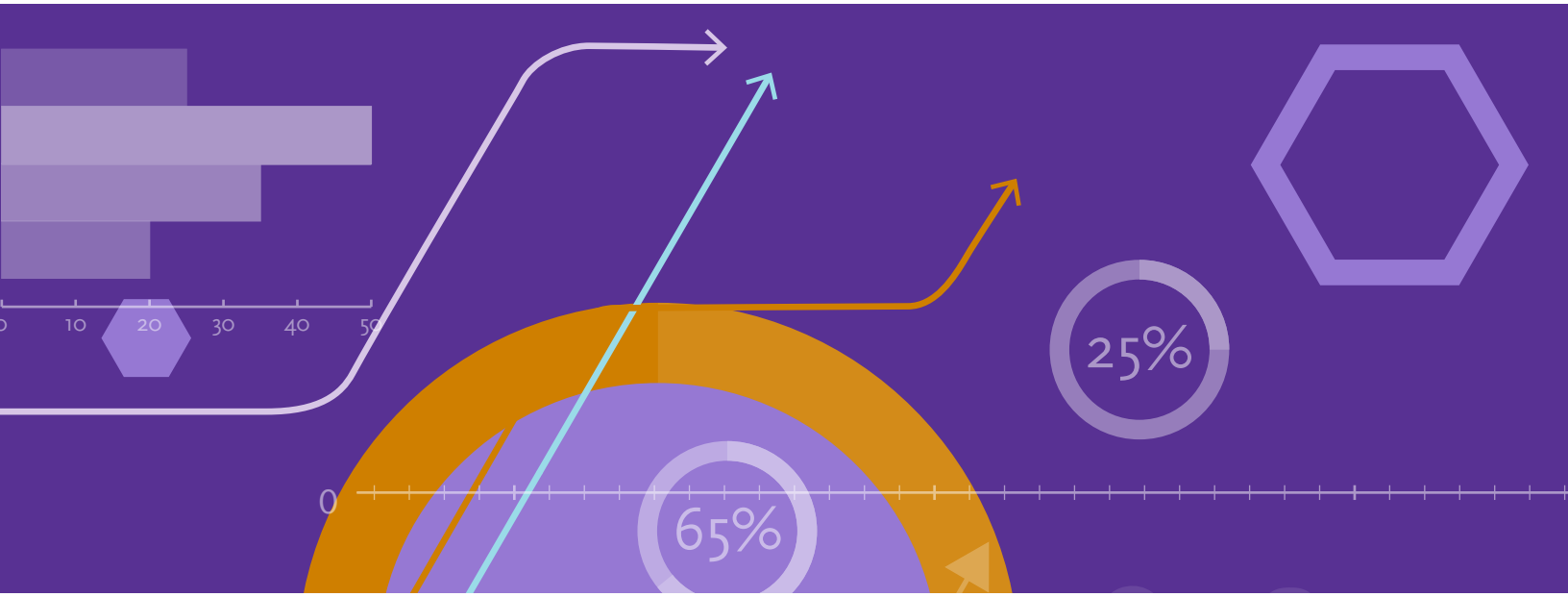
NEJM Catalyst brings health care executives, clinical leaders, and clinicians together to share innovative ideas and practical applications for enhancing the value of health care delivery. From a network of top thought leaders, experts, and advisors, our digital publication, quarterly events, and qualified Insights Council provide real-life examples and actionable solutions to help organizations address urgent challenges affecting health care.



781.893.3800 | CATALYST@NEJM.ORG
860 WINTER STREET, WALTHAM, MA 02451-1413 USA | catalyst.nejm.org

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