### Abbreviated Attitude Survey: **AI-Powered Clinical Pathways**

(5-point Likert scale — Strongly Disagree · Disagree · Neutral · Agree · Strongly Agree)

| **#** | **Domain** | **Survey Item** |
| --- | --- | --- |
| **1** | **Perceived Usefulness** | AI-powered clinical pathways can **help me deliver more equitable care** |
| **2** | Perceived Usefulness | Using AI-powered pathways can **reduce the likelihood of medical errors i**n my practice |
| **3** | Perceived Usefulness | Using AI-powered pathways can **increase my time for direct patient interaction** |
| **4** | **Threat to Autonomy** | AI-powered pathways **threaten my professional autonomy** as a clinician |
| **5** | Threat to Autonomy | Relying on clinical pathways **diminishes the art of medicine** and individual clinical judgment |
| 6 | Trust | If an AI-powered pathway’s recommendation **conflicts with my clinical judgment, I will follow my clinical judgement.** |

Key Features:

1. Equitable, Evidence-Based Pathways: CarePathIQ’s AI-driven pathways are designed to standardize care and promote health equity by minimizing resource utilization and care delivery variation. By providing consistent, evidence-based guidelines across clinical scenarios, these pathways ensure that every patient receives the same high-quality care regardless of identity, location, or provider, leading to equitable outcomes.

~~??2. Automated Order Sets with Embedded Logic: Intelligently designed order sets featuring default values, conditional options, and simplified choices to ease the documentation workload for clinicians.~~

2. Expert Guidance on Implementation & Evaluation: CarePathIQ leverages large language models to produce educational pamphlets describing pathway and clinical significance for dissemination to staff before and after go live, lectures for staff and trainees on the evidence between each pathway, report templates for process and outcome metrics that are specific to each pathway, and project management tools to support operationalizing each pathway (such as Gantt charts, etc.). Applies implementation science principles to guide effective operationalization and evaluation of the clinical pathway.

3. Optimized Clinical Documentation: Templates that assist with medical decision-making, assessments, and planning, coupled with coding support for accurate billing (and criteria for critical care) and optimized reimbursement.

4. ??Culturally Adaptable Discharge and Patient Education: Language-customizable discharge instructions and educational resources to meet different health literacy needs, enhancing patient comprehension and engagement. CarePathIQ also supports smooth transitions of care, helping patients move seamlessly from the clinical setting back to their community with comprehensive, structured discharge plans and community-focused resources (providers with access to social workers or other interdisciplinary partners are recommended to leverage their expertise in community resource referrals to preserve patient trust). This standardization reduces disparities, streamlines resource use, and enhances continuity of care, ensuring that patients are supported through every stage of their healthcare journey.

5. ??Integrated Clinical Decision Support Portal: A central portal offering access to institution-approved pathways and educational materials, where clinicians can use ChatGPT to:

- Locate specific pathways for decision support.

- Develop patient-centered communication for shared decision-making, including risk/benefit discussions.

- Facilitate interdisciplinary collaboration with suggested consult prompts and phrasing guidance.

Logo Concept:

The logo features a branching pathway with interconnected nodes, symbolizing CarePathIQ's mission to democratize intelligent, adaptable healthcare pathways. At its core, a depiction of a healthcare provider and patient highlights the application’s commitment to equitable, patient-centered care. Warm and cool colors blend to evoke compassion, trust, and clarity, underscoring the non-profit’s dedication to accessibility and quality in healthcare.

Website:

* Start a company (speak with Jen Wiler, Kelly Bookman, Sean Michael, Rich Zane, Dowin Boatright, and Bob Rohrbaugh beforehand for advice on maximizing ownership/control over my intellectual property) OR state non profit to national 501©-> also IRB for research through this (pre and post module surveys, data entry in surveys linked with prompt engineers to get a national assessment of priorities in clinical workflows and can further stratify based on location (US vs international, northeast vs west), type of institution (academic vs community, nonprofit vs private vs county), discipline (emergency medicine vs surgery), rank (student or resident vs professor, race/ethnicity, age, gender/sex, etc.
  + IRB research can also include brief surveys on AI in healthcare, LLM analysis of transcripts of zoom meetings on varying parts of the pathway design and implementation process to provide iterative feedback in improving collaboration with specific actions to take before and/or during the next meeting
* ?Get a lawyer to also make sure I am not held legally liable for any medical decision making done using my clinical pathways (what disclaimers to include, etc) and also whether it is possible to [**patent**](https://www.patentnext.com/2024/03/the-u-s-patent-office-provides-inventorship-guidance-for-ai-assisted-inventions/#:~:text=Input%20into%20an%20AI%20system,system%20(Guiding%20Principle%202).) my templates and prompt engineering schema
* Recognized by: Moore Foundation, Johns Hopkins, Mount Sinai (floating banner at bottom)
* About Me (Tehreem) tab – other tabs could be Education (with each module being comprised of short 3-5 min lectures of animations), AI Design, Operations Toolkit (includes the templates I created for people interested in working on a pathway) and Podcast
* Hire a website designer, especially to manage login access and customer analytics (such as demographics, number of unique users, number of visits, number of downloads,
* Future hire coder to create report on trends in data entry in the structure data fields of the prompts -> future research
* Lectures/Modules: free, but you need to submit an email (similar to Becker’s review) to login and access each module
  + Take studio videos of me in professional hair and makeup for each lecture
  + New headshots
  + Hire professional videographer to develop corresponding graphics or animation and interlay those into interactive lectures.
  + To start the module you have to take a brief pre-quiz and to access the last 5 minutes of the lecture (which includes a case study or something enticing for a customer) you have to take the post-quiz
* Free vs Premium Paid Access (three free deliverables facilitated by ChatGPT and additional coding (such as for visual outputs) before you need to pay for a monthly subscription) vs Business Access OR IF NON PROFIT, the member gets “premium” access after getting ten free deliverables if they complete a survey including fundamental questions on AI in healthcare and submit a written testimony that reflects their level of seniority and size of organization (instead of any specific identifiers if the person wants to remain anonymous)
  + Applying decision science/clinical informatics to ChatGPT prompt engineering for the stepwise creation of templates to allow user feedback at intervals to modify code appropriately before producing the final evidence-based clinical pathways based on examples I previously worked on (ie. HIV screening) with demonstrated success (with specified measures such as reduced admissions, etc).
    - Input certain information in structured fields (that are later referenced in the prompts for ChatGPT) -> hire a programmer to create this for me for the website
    - Reference: https://chatgpt.com/share/671eccff-c614-800c-834b-0604d0b2f389
  + Applying clinical informatics to ChatGPT prompt engineering for the stepwise creation of wire-mapped order sets, panels, and smartsets (such as for discharge) with embedded conditional logic, defaults, and single vs multi-select choices.
  + Applying clinical informatics to ChatGPT prompt engineering for the stepwise creation of content and templates (ie. Medical decision making, assessments and plans), in addition to specific recommendations for level of care and ICD-10 Z codes) to support clinical documentation integrity that minimizes admission denials, and maximizes coding, billing, and final reimbursement
  + Applying clinical informatics to ChatGPT prompt engineering for the stepwise creation of patient education materials that can be adapted to varying languages and health literacy
  + Guidelines on how to establish bidirectional clinical decision support between the pathways and order sets
* Business membership (if non profit, organization gets “business” membership by becoming a CarePathIQ Champion in which they are listed on website and go on a podcact for one session describing a use case or challenge that we work through together via application of change management strategy or informatics)
  + One option for “equity” to Sinai when I disclose this to them is to grant them free membership (which is equivalent to at least 10 years of Agile MD vendor cost) DIFFERENT if non profit
  + Portal that includes all internal institution-approved clinical pathways and patient education materials
    - Can use chat gpt to search clinical pathways to help a clinician user find a specific pathway to answer a specific clinical decision question based on the institution-approved pathway
    - Can use chat gpt to support scripting for patient-centered communication, such as when discussing risks and benefits as part of shared-decision making
    - Can use chat gpt to support scripting that facilitates interdisciplinary team communication. Examples:
      * recommended consult based on pathway and how to phrase the consult question
  + How to get a tax deduction for free membership given to safety net hospitals?
  + ? try to get an API with Epic and meet FHIR guidelines -> competitive advantage to AgileMD with additional features above but decreased transactional costs.
    - Can potentially integrate patient data such as lab values or vitals to adjust pathway-drive recommendations?

Course Title**:** Development and Implementation of AI-Augmented Clinical Pathways to Advance Health Equity

**PROJECT DESCRIPTION**

This project aims to support clinicians and trainees in becoming champions of an equitable learning health system through development and implementation of evidence-based clinical pathways. By standardizing care and reducing variation in diagnostics, treatment, and disposition, clinical pathways mitigate impact of bias on clinical reasoning. Pathways are instrumental in clinical settings where time and resource constraints can increase the potential impact of implicit bias on patient care, particularly for those historically marginalized in healthcare.

The goal of the proposed didactic for residents entitled “Clinical Pathways: Advancing Health Equity in Clinical Reasoning” is to empower trainees to identify areas of significant variation in their bedside patient care and subsequently apply quality improvement methodology to achieve evidence-based structure and equity in their clinical reasoning.

Primary objectives are:

1. Understand existing health disparities and how adverse health outcomes can be influenced by variation in diagnostics, treatment, and disposition in patient care.
2. Learn how to apply National Quality Forum’s Disparities-Sensitive Measure Assessment Protocol in selection of clinical pathways.
3. Identify examples of clinical pathways that successfully improved quality and equity of patient care.
4. Learn how to apply a standardized approach in shared decision making with patients.
5. Identify opportunities for interdisciplinary engagement of care partners outside medicine, such as social work and pharmacy, in development and implementation of clinical pathways.
6. Learn how to apply the RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework in assessing the viability and sustainability of a clinical pathway.

The digital asynchronous didactic component of the project will be developed in alignment with the validated “System of Indicators for Quality Assessment of Didactic Materials in Online Education” as published by Marciniak and Caliz. The project will comprise of an asynchronous five-session video lecture series followed by an interactive workshop during which trainees will organize into small groups to develop a clinical pathway and present a draft with proposed measures of success. The lecture topics will include:

Expand to have content explicitly include pharmacist, social work, nursing, health administrator, public health official

Team-based project in workshop

Module A: “Clinical Pathways: Definition & Domains”

Lecture 1: What is a Clinical Pathway?

* Supports system design: “Every system is perfectly designed to get the results it gets”

Lecture 2: “Clinical Pathway Domain – Diagnostics”: Review clinical diagnoses with significant variation by demographics and examples of clinical pathways that attempt to reduce that variation. One example would be a clinical pathway that alleviated sex-based differences in risk-stratification or non-invasive testing for acute coronary syndrome.

Lecture 3: “Clinical Pathway Domain – Treatment”: Review existing sources of variation in medical treatment and examples of clinical pathways that mitigate disparities in domains like pain management or use of restraints for agitated patients.

Lecture 4: “Clinical Pathway Domain – Disposition”: Review existing disparities in disposition, such as racial disparities in patients leaving against medical advice and demonstrate use of interdisciplinary pathways to support safe transition back to the community. Examples of pathways discussed will be discharge of patients with transportation needs from the ED and a post-discharge care transitions pathway for vulnerable patients, such as callbacks for persons living with dementia.

Module B: “Clinical Pathways: Design & Implementation” through application of DMAIC Model and utilize the example of VTE (or hypoglycemia) pathway development in each session

Lecture 1: DMAIC - Define

* Scope
  + What is the problem the clinical pathway would address?
  + How often does it happen?
  + Who are the key stakeholders?
* Value stream mapping
* Voice of the Customer (future iterations with capture of lived experiences/evidence through patient involvement)

Lecture 2: DMAIC - Measure

* How do we measure the problem (in this case, variation in diagnosis-specific diagnostics, treatment, and disposition and disparities by race, ethnicity, preferred language, payer, socioeconomic status, etc.?)
* What data do we collect to measure it, and how reliable is that data?
  + Process measures
  + Outcome measures

Lecture 3: DMAIC - Analyze

* What is the root cause (in this case, for variation in diagnosis-specific diagnostics, treatment, and disposition Ishikawa diagram?)
  + The 5 Why’s
  + Pareto Chart
  + Ishikawa diagram

Lecture 4: DMAIC - Improve

* What are all possible evidence-based decision trees to include in the clinical pathway?
* Which ones will work best? Consider your specific clinical team, department, or site’s structure, resources, culture, informal influencers (including resistance to clinical pathways)
* When, where, and how should we implement the clinical pathway? Consider timeline, setting, and platform for pathway dissemination.
* Implementation Strategy: <https://publications.aap.org/hospitalpediatrics/article/11/5/478/180722/A-Quality-Improvement-Approach-to-Decreasing?autologincheck=redirected>

Module C: “Clinical Pathways: Impact Assessment & Evaluation”

Lecture 1: DMAIC - Control

* Is the clinical pathway reliably followed?
  + Run charts
* Has the clinical pathway solved the problem it was designed to address?
  + Regression analysis
* Monitoring Health Equity: Teach residents how to apply the RE-AIM framework to monitor impact of clinical pathways on patient care and population health outcomes. Residents will learn how clinical pathways can track specific clinical reasoning domains, such as diagnostics through fidelity to electronic health record embedded order sets. This data can inform a dashboard that records clinical decisions and outcomes to proactively identify disparities with actionable data. Additional monitoring can track disparities in deviations from clinical pathways and how they may impact patient experience and health outcomes through interdisciplinary case review.

The workshop will comprise of pre-assigned interdepartmental resident small groups who will each work on a domain of clinical reasoning with significant variation that they internally identified. Residents will come to the workshop prepared with peer-reviewed literature, society recommendations, and other clinical guidelines to support development of a clinical pathway on their selected topic. Workshop participants will structure their drafts based on a clinical pathway template that will be provided to them. The workshop will conclude with each small group presenting their clinical pathway draft and receiving feedback from the large group of residents and faculty in attendance.

After the workshop, residents will have the opportunity to present their clinical pathway to the System Emergency Department System Evidence-Based Practice Steering Committee for approval. Residents will also be encouraged to work with clinical informaticists to develop clinical decision support tools that will link to the pathway in Epic. I will leverage my experience in clinical informatics to support any electronic health record builds, including integrated artificial intelligence algorithms that are developed based on the evidence-based clinical pathways.

Approved clinical pathways will be presented by residents at their respective graduate medical education conferences to support all trainee education on diagnostic excellence and become familiar with on-shift educational tools to support clinical reasoning for equitable and high-quality care. Additionally, residents will be invited to partner with department statisticians, and I will be available as a faculty mentor with my master’s background in bioinformatics to mentor residents in analyzing impact of clinical pathway on process and outcome measures. Some examples would be department length of stay, time to disposition, utilization of high-intensity resources such as CT imaging or inpatient admissions, repeat ED visits or hospital readmissions, unanticipated escalation in level of care within 24 hours, and other morbidity and mortality outcomes. All analysis will be performed with a critical examination of impact of pathway on care of patients with historically marginalized backgrounds by performing stratified analysis based on race, ethnicity, limited English proficiency, and public health insurance for instance.

With support from the Dean and Vice President for Equity in Clinical Care of the Icahn School of Medicine at Mount Sinai and Mount Sinai Health System, Dr. Yvette Calderon, and the Dean for Graduate Medical Education, Dr. Michael Leitman, a pilot workshop session will be held this spring as part of the Graduate Medical Education Leadership Development Program. The goal of the pilot would be to review preliminary feedback from interdepartmental residents to identify any gaps in the curriculum and refine them prior to the design of the proposed didactic. Although the target audience for this didactic is residents, this project is innovative in its accessible approach to improving clinical reasoning that can be scaled for medical students and faculty.

An adapted version of the validated 30-item “The Beliefs, Attitudes, Skills and Confidence in Quality Improvement Scale” will be employed to examine the impact of the didactic on resident education targeting the intersection of quality improvement and health equity to advance diagnostic excellence. Resident participants will complete the survey both before initiating the digital asynchronous component of the didactic and after the final workshop. Pre-post analysis will be performed to evaluate whether the didactic successfully improved trainee knowledge, skills, and attitudes towards quality improvement.

Create a separate website (and/or phone app?) with a portal that gives a preview of modules and lectures but that people have to submit their demographics to register and before starting modules have to submit a pre-questionnaire and after each module (or lecture) is completed they have to complete a corresponding post-questionnaire question before being able to access next module (or lecture)

Potential website name “Equitable Dx” (front of titled ambulance becomes D and + becomes x) and apply for trademarking name & logo and website domain

Website tabs

1. Modules
2. ??Worksheets (cannot be accessed until all modules are completed and post-questionnaire questions have been answered)
   1. based on Module 2 for clinical pathway design & implementation
   2. based on Module 3 for clinical pathway impact assessment & evaluation
   3. facilitator guide for an interactive interdisciplinary workshop for pathway development
3. Case studies
   1. Conference presentations
   2. Didactics
   3. Articles
   4. Peer-Reviewed publications
   5. Resident Deliverables
4. Our Team (down the road)
   1. Sponsors & Advisors
   2. Seeking software engineer partners to develop AI applications
5. Reach out to Oxford or Mayo Clinic Press for a book on Leveraging Artificial intelligence to Advance Equity in Healthcare
6. ACEP HIT Committee’s goal and paper to publish through JACEP can focus on a framework for leveraging artificial intelligence to advance equity in acute unscheduled care
   1. Digital divide
   2. Use of race and sex in algorithms, such as risk for poor surgical outcomes

Clinical pathways will be critically and iteratively examined for persistent variation in clinical reasoning domains that may yield health inequities in process and outcome measures. Time-series analyses will be performed for each clinical pathway to evaluate the effectiveness of clinical pathway implementation on care delivery. A sub-stratified analysis will be performed to specifically assess the impact of clinical pathway implementation on reducing health disparities for patient groups such as those who are publicly insured or those with limited English proficiency.

The primary deliverable of this project entails an interdepartmental asynchronous curriculum followed by an interactive workshop. The workshop will yield additional deliverables of institutional approved clinical pathways as well as electronic health record embedded clinical decision support such as order sets developed by didactic participants. Residents will subsequently be encouraged to lead graduate medical education sessions reviewing the evidence-based tools for on-shift teaching. Additionally, I will mentor residents in submitting national conference presentations and peer-reviewed manuscripts describing implementation and impact of each clinical pathway. Finally, clinical pathway data will be integrated into a Health Equity Dashboard actively being developed for the health system by the institutional mentor for this project.

Ultimately, this project will promote interdisciplinary diagnostic excellence and support our hospital and health system in operating as a high reliability organization. Trainee-led interdisciplinary pathway development and implementation will counter existing power dynamics in medicine and any resultant deviations in standard of care. My vision for this project is to positively impact both institutional and national learning health systems on leveraging clinical pathways to improve quality and equity of patient care.

The next steps after this pilot (such as for a future grant) will be integrating insight from a patient advisory council on clinical pathway review. Examples are patient or “voice of the customer” in the Define phase of DMAIC, appropriately integrating shared decision making, especially in the disposition domain, developing and utilizing patient-centered or patient-reported outcomes in evaluation, and having care planning education materials (written and multimedia such as video) that are appropriately patient-centered. One possible future grant would be the [National Academy of Medicine](https://dxexscholars.nam.edu/program/) program “Leveraging Artificial Intelligence to Deliver More Patient-Centered Communication in a High-Acuity and Safety Net Healthcare Setting”.

Discuss the impact of bias in shared decision-making and how to ensure patients' autonomy with historically marginalized identities is respected when adhering to clinical pathways. The session will introduce residents to the SHARE approach developed by the Agency for Healthcare Research and Quality, which provides structured steps to take when engaging in shared decision-making with each patient. It will also guide trainees on engaging in culturally sensitive bedside discussions with patients with limited English proficiency or low health literacy. Residents will be encouraged to integrate SHARE into decision trees in clinical pathways, such as guidance on helping patients explore and compare treatment options.

In addition to didactic, future evaluation can look at the impact of clinical pathways that are optimized based on patient input on process measures and patient-reported outcome/other health outcome measures.

<https://www.cdc.gov/pcd/issues/2024/24_0245.htm>

<https://www.cdc.gov/health-equity/what-is/communicating.html>

<https://pmc.ncbi.nlm.nih.gov/articles/PMC8607970/>

<https://lowninstitute.org/leveraging-ai-to-reduce-health-disparities-a-closer-look-at-the-possibilities/>

<https://fas.org/publication/improving-health-equity-through-ai/>

<https://www.healthaffairs.org/content/forefront/c-c-e-s-s-ai-new-framework-advancing-health-equity-health-care-ai>

Decision science plays a crucial role in the application of artificial intelligence (AI) to healthcare, helping to bridge the gap between data analysis and effective clinical decision-making. Here's an overview of how decision science and AI intersect in healthcare:

## Integration of AI and Decision Science in Healthcare

### Enhancing Clinical Decision Support

Decision science provides a framework for incorporating AI-driven insights into clinical decision-making processes. AI algorithms can analyze vast amounts of patient data, medical literature, and clinical guidelines to provide evidence-based recommendations to healthcare providers[1]. This integration allows clinicians to make more informed decisions by considering a wider range of factors and potential outcomes.

### Optimizing Treatment Plans

By combining decision science principles with AI capabilities, healthcare systems can develop personalized treatment plans that consider multiple variables and potential outcomes. This approach enables:

- Better risk stratification of patients

- More accurate prediction of treatment outcomes

- Optimization of medication dosages

- Improved management of complex cases[4]

### Improving Diagnostic Accuracy

AI-powered diagnostic tools, when integrated with decision science frameworks, can significantly enhance the accuracy and speed of diagnoses. These systems can:

- Analyze medical imaging with high precision

- Identify patterns in patient data that may indicate specific conditions

- Provide differential diagnoses for complex cases[3]

## Applications of Decision Science and AI in Healthcare

### Predictive Analytics

Decision science helps in structuring predictive models that use AI to forecast patient outcomes, disease progression, and potential complications. This allows for proactive interventions and more effective resource allocation[5].

### Population Health Management

By applying decision science principles to AI-driven population health models, healthcare organizations can:

- Identify high-risk patient groups

- Develop targeted intervention strategies

- Optimize resource allocation for preventive care[4]

### Clinical Workflow Optimization

Decision science frameworks can guide the implementation of AI tools to streamline clinical workflows, reducing administrative burden and allowing healthcare providers to focus more on patient care[2].

## Challenges and Considerations

### Ethical Decision-Making

As AI becomes more prevalent in healthcare decision-making, it's crucial to apply ethical frameworks from decision science to ensure that AI-driven recommendations align with patient values and societal norms[1].

### Interpretability and Transparency

Decision science principles can help in developing AI models that are more interpretable and transparent, which is essential for building trust among healthcare providers and patients[6].

### Integration with Clinical Expertise

The successful application of AI in healthcare requires a balance between algorithmic recommendations and clinical judgment. Decision science provides methodologies for effectively combining AI insights with human expertise[1].

## Future Directions

As AI and decision science continue to evolve, we can expect to see:

- More sophisticated clinical decision support systems that can handle complex, multi-factorial healthcare decisions

- Increased use of AI in shared decision-making processes between providers and patients

- Further integration of AI-driven insights into medical education and training programs[1][6]

In conclusion, decision science plays a vital role in harnessing the power of AI for healthcare by providing frameworks for translating data-driven insights into actionable, ethical, and patient-centered decisions. As these fields continue to advance, they have the potential to significantly improve healthcare outcomes, efficiency, and personalization.

Citations:

[1] https://medinform.jmir.org/2022/8/e36199/

[2] https://www.montoux.com/what-is-decision-science

[3] https://www.aha.org/aha-center-health-innovation-market-scan/2023-05-09-how-ai-improving-diagnostics-decision-making-and-care

[4] https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-023-04698-z

[5] https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-021-01488-9

[6] https://www.frontiersin.org/journals/digital-health/articles/10.3389/fdgth.2021.645232/full

[7] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/>

The integration of decision science with AI has significant potential to advance health equity in healthcare. Here's an overview of how this combination can be leveraged:

## Enhancing Clinical Decision Support

Decision science frameworks can guide the development of AI-powered clinical decision support systems that prioritize health equity:

- AI algorithms can analyze vast amounts of patient data, medical literature, and clinical guidelines to provide evidence-based recommendations[1].

- By incorporating decision science principles, these systems can be designed to consider social determinants of health and prioritize performance for populations experiencing worse health outcomes[2].

This approach allows for:

- Better risk stratification of patients from diverse backgrounds

- More accurate prediction of treatment outcomes across different populations

- Optimization of care plans that account for social and environmental factors

## Addressing Bias and Promoting Fairness

Decision science can help mitigate bias in AI systems and promote fairness:

- Frameworks for ethical decision-making can be applied to AI development to ensure algorithms don't perpetuate or exacerbate existing health disparities[1][3].

- The Health Equity Assessment of machine Learning performance (HEAL) framework, for example, provides a methodology to assess whether AI technologies prioritize performance for patient populations experiencing worse outcomes[2].

## Improving Resource Allocation

By combining decision science with AI-driven predictive analytics, healthcare organizations can:

- Identify high-risk patient groups more accurately, especially among underserved populations

- Develop targeted intervention strategies that address health inequities

- Optimize resource allocation to focus on preventive care and early interventions for vulnerable communities[1]

## Enhancing Community Engagement

Decision science principles can guide the integration of AI in ways that promote community involvement:

- Collaborative efforts should include physicians, patients, and communities from diverse backgrounds in the development and implementation of AI solutions[1].

- This approach ensures that AI technologies are culturally sensitive and address the specific needs of different populations.

## Promoting Transparency and Interpretability

Decision science can help in developing AI models that are more interpretable and transparent:

- This is crucial for building trust among healthcare providers and patients, especially in communities that have historically been marginalized or underserved[3].

- Explainable AI techniques can be used to help patients and providers understand how AI-driven recommendations are made, promoting informed decision-making.

## Addressing Social Determinants of Health

The integration of decision science and AI can help in:

- Analyzing complex datasets that include social, environmental, and economic factors affecting health outcomes[4].

- Developing interventions that address root causes of health inequities, not just symptoms.

## Challenges and Considerations

While the potential is significant, there are challenges to address:

- Ensuring diverse and representative data sets to train AI models[5].

- Developing regulatory frameworks that oversee the equity dimensions in AI implementation[1].

- Balancing the use of AI with human expertise and judgment in clinical settings.

In conclusion, the integration of decision science with AI offers a powerful approach to advancing health equity. By providing frameworks for ethical, transparent, and equitable AI development and implementation, decision science can help ensure that AI technologies in healthcare benefit all populations, particularly those who have been historically underserved or marginalized. This integration has the potential to transform healthcare delivery, making it more personalized, proactive, and equitable.

Citations:

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9976641/

[2] https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(24)00058-0/fulltext

[3] https://fas.org/publication/improving-health-equity-through-ai/

[4] https://pmc.ncbi.nlm.nih.gov/articles/PMC10844447/

[5] https://www.cdc.gov/pcd/issues/2024/24\_0245.htm

[6] https://ssir.org/articles/entry/ai-nonprofits-health-care

[7] https://medinform.jmir.org/2022/8/e36199/

Addressing decision biases in clinical pathways is crucial to advancing health equity. Biases, whether conscious or unconscious, can lead to disparities in care, perpetuate inequality, and affect patient outcomes, particularly for marginalized groups. To mitigate these biases and promote health equity, it is essential to consider the following strategies for different types of decision biases:

### 1. \*\*Anchoring Bias\*\*

Anchoring bias occurs when clinicians rely too heavily on an initial piece of information, potentially leading to premature conclusions or incorrect diagnoses.

\*\*Addressing it:\*\*

- \*\*Training on reflective practice:\*\* Encourage clinicians to reconsider initial diagnoses and think critically about alternative diagnoses, especially when treating patients from diverse backgrounds.

- \*\*Structured decision-making tools:\*\* Implement checklists or clinical guidelines that require consideration of multiple diagnostic possibilities, particularly when encountering patients with atypical presentations.

- \*\*Patient-centered approaches:\*\* Encourage clinicians to gather comprehensive patient histories and listen to patient experiences, preventing reliance on early, incomplete information.

### 2. \*\*Confirmation Bias\*\*

Clinicians may search for or interpret evidence in ways that confirm their preexisting beliefs, which can reinforce existing inequalities.

\*\*Addressing it:\*\*

- \*\*Implicit bias training:\*\* Help clinicians recognize and challenge their preconceptions, especially those related to race, gender, socioeconomic status, or disability.

- \*\*Collaborative decision-making:\*\* Foster interdisciplinary discussions or second opinions, especially when biases could skew individual decision-making.

- \*\*Incorporate patient data:\*\* Utilize data-driven decision support systems that help assess clinical situations more objectively, reducing the risk of relying on confirmation bias.

### 3. \*\*Availability Bias\*\*

Availability bias happens when clinicians make decisions based on recent or memorable cases rather than the full spectrum of possibilities, which may lead to stereotyping.

\*\*Addressing it:\*\*

- \*\*Data dashboards and audit feedback:\*\* Provide clinicians with access to population health data to show trends in treatment and outcomes across different demographic groups.

- \*\*Balanced exposure:\*\* Ensure clinicians are exposed to a diverse range of cases during their training, emphasizing the variability within patient populations, especially for conditions that affect marginalized groups differently.

- \*\*Equity audits:\*\* Routinely audit clinical decisions to identify and address patterns where availability bias may contribute to health disparities.

### 4. \*\*Implicit Bias\*\*

Implicit biases are unconscious attitudes or stereotypes that affect decision-making, often leading to unequal treatment.

\*\*Addressing it:\*\*

- \*\*Bias-awareness training:\*\* Regular, evidence-based training that focuses on the impact of implicit biases, particularly regarding race, gender, sexual orientation, and disability.

- \*\*Patient decision aids:\*\* Create standardized tools that present clinical options and outcomes in ways that minimize personal biases from influencing decision-making.

- \*\*Cultural competency:\*\* Build programs that help clinicians understand and respect different cultural perspectives and how they relate to healthcare access and treatment.

### 5. \*\*Framing Bias\*\*

This bias involves being influenced by how information is presented (e.g., focusing on potential negative outcomes more than positive ones), which can affect decisions regarding treatment options.

\*\*Addressing it:\*\*

- \*\*Inclusive language:\*\* Develop communication guidelines that ensure treatment options and risks are framed in a neutral, patient-centered way, avoiding fear or assumptions about certain populations.

- \*\*Patient education:\*\* Empower patients by providing clear, unbiased information that allows them to participate fully in decisions about their care, which can reduce the clinician’s reliance on biased framing.

- \*\*Shared decision-making models:\*\* Use decision frameworks that involve patients and their families in discussions about their care, helping counter biases by broadening the decision-making process.

### 6. \*\*Stereotyping Bias\*\*

Stereotyping can lead clinicians to make assumptions about patients based on race, ethnicity, gender, or other demographic factors, rather than on individual clinical information.

\*\*Addressing it:\*\*

- \*\*Contextual inquiry:\*\* Encourage clinicians to explore the social and economic contexts of a patient’s life, which may influence their health, rather than rely on demographic generalizations.

- \*\*Equity-focused protocols:\*\* Develop clinical pathways that account for social determinants of health and explicitly guide clinicians to consider how these factors may influence outcomes.

- \*\*Patient-reported outcomes:\*\* Integrate patient feedback and self-reported experiences into the decision-making process, which helps personalize care and counteract stereotypical assumptions.

### 7. \*\*Overconfidence Bias\*\*

This bias occurs when clinicians overestimate their ability to make accurate judgments, which can negatively impact decision-making, especially when treating complex or unfamiliar cases.

\*\*Addressing it:\*\*

- \*\*Regular feedback loops:\*\* Provide clinicians with real-time feedback about their decision-making accuracy, helping them recalibrate when necessary.

- \*\*Continuous professional development:\*\* Encourage lifelong learning and self-assessment practices among clinicians, particularly in areas like social determinants of health and cultural humility.

- \*\*Decision-support systems:\*\* Utilize AI-based decision aids that prompt clinicians to review potential alternative diagnoses or treatment plans, especially for patients from underserved groups.

### Conclusion

By addressing decision biases systematically within clinical pathways, healthcare organizations can promote more equitable outcomes. Implementing bias-reduction strategies, fostering awareness, and utilizing decision-support tools help ensure that care is personalized, inclusive, and equitable for all patients.

Guideline modeling can play a pivotal role in integrating artificial intelligence (AI) within clinical pathways to promote health equity. Guideline modeling involves formalizing clinical guidelines—recommendations for diagnosing and treating specific conditions—into standardized, computable formats that AI systems can interpret and apply. By leveraging AI in clinical pathways through well-designed guideline models, healthcare providers can ensure consistent, equitable care delivery, especially for marginalized and underserved populations. Here's how guideline modeling and AI can be used together to advance health equity:

### 1. \*\*Standardizing Clinical Decision-Making\*\*

AI systems can use formalized guidelines to ensure that clinical decisions are consistent across different providers and patient populations, reducing the variability that contributes to health disparities.

\*\*How it promotes equity:\*\*

- \*\*Reducing biases in care:\*\* By using standardized decision-making protocols based on evidence-based guidelines, AI can help mitigate biases that arise from subjective judgments by clinicians. This ensures that all patients receive care aligned with best practices, regardless of their background.

- \*\*Personalized guideline application:\*\* AI can dynamically tailor guidelines to individual patients by incorporating personalized factors such as comorbidities, genetic markers, and social determinants of health (SDOH), ensuring that marginalized populations receive more individualized, precise care.

### 2. \*\*Addressing Gaps in Clinical Guidelines\*\*

Many clinical guidelines are based on research that predominantly includes populations from higher socioeconomic backgrounds, with less consideration for minority or marginalized groups. AI can help address this by identifying and filling gaps in guideline relevance for underserved populations.

\*\*How it promotes equity:\*\*

- \*\*Adaptive learning:\*\* AI systems can continuously learn from real-world data and patient outcomes, identifying when current guidelines fall short for specific demographic groups. This feedback can guide clinicians in adapting treatment plans to be more inclusive.

- \*\*Equity-based guideline development:\*\* AI can analyze health disparities by comparing patient outcomes across populations. These insights can help inform the creation of guidelines that explicitly address inequities, integrating SDOH and other equity-related factors.

### 3. \*\*Augmenting Data with Social Determinants of Health (SDOH)\*\*

AI-driven clinical pathways can integrate SDOH—such as housing, income, education, and access to care—into guideline models. These non-clinical factors often contribute to disparities in health outcomes and can be overlooked in standard clinical decision-making.

\*\*How it promotes equity:\*\*

- \*\*Personalized care pathways:\*\* AI can incorporate SDOH into clinical guidelines to personalize care. For example, if a patient’s SDOH indicates limited access to transportation or nutritious food, AI could adjust treatment recommendations to accommodate these challenges (e.g., recommending local telehealth services or home-based care options).

- \*\*Predictive analytics for at-risk populations:\*\* AI can analyze patient data along with SDOH to identify patients who are at higher risk for poor outcomes due to systemic inequities. This enables clinicians to provide earlier interventions and allocate resources more effectively.

### 4. \*\*Reducing Implicit Bias in Clinical Pathways\*\*

Implicit bias in clinical decision-making contributes significantly to health disparities. By using guideline modeling to automate decision-making processes, AI can help reduce the influence of bias by relying on objective data and standardized protocols.

\*\*How it promotes equity:\*\*

- \*\*Bias-resistant decision support:\*\* AI-based clinical decision support systems (CDSS) can apply guidelines without the unconscious biases that may affect human decision-making. These AI systems can flag when clinician decisions deviate from guidelines due to potentially biased judgment and suggest more equitable alternatives.

- \*\*Diversifying training datasets:\*\* When building AI models for clinical pathways, guideline modeling can help ensure that datasets used for AI training are representative of diverse populations. AI systems can be retrained with new datasets that reflect a wider variety of patient populations, leading to more inclusive and accurate decision-making.

### 5. \*\*Enhancing Access to Care\*\*

AI-guided clinical pathways can help streamline care delivery, especially in underserved or rural areas where access to specialized care is limited. Guideline modeling enables AI-driven telemedicine platforms or mobile health apps to provide standardized care remotely.

\*\*How it promotes equity:\*\*

- \*\*Telemedicine and remote monitoring:\*\* AI-driven systems can offer decision support and guideline-based care in remote settings. Patients from marginalized communities can access care that adheres to the same evidence-based standards as in-person visits, improving access to high-quality care.

- \*\*Task-shifting and automation:\*\* In resource-limited settings, AI-enabled systems can assist lower-level healthcare workers in following guideline-based protocols, reducing the reliance on specialists who may be scarce in underserved areas. This can help expand equitable access to care.

### 6. \*\*Tracking and Addressing Disparities in Real-Time\*\*

AI can continuously monitor patient outcomes across different populations, providing real-time insights into how clinical pathways are performing and where inequities might be emerging.

\*\*How it promotes equity:\*\*

- \*\*Data-driven feedback loops:\*\* AI can track whether certain populations are benefiting equally from guideline-based interventions. If disparities are detected, guideline models can be updated or flagged for review, ensuring care pathways remain responsive and equitable.

- \*\*Outcome audits and transparency:\*\* AI systems can conduct automated audits of care pathways and patient outcomes, ensuring that all demographic groups are receiving guideline-compliant care. These audits can expose patterns of unequal care and prompt corrective actions.

### 7. \*\*Predictive and Preventive Care\*\*

AI, when coupled with clinical guidelines, can be used for predictive modeling to identify patients at risk for future health issues, especially in populations that are often overlooked by traditional healthcare systems.

\*\*How it promotes equity:\*\*

- \*\*Early detection of disparities:\*\* AI models can predict which populations are most likely to experience poor health outcomes due to social and clinical factors. These insights allow for earlier interventions, reducing the long-term impact of health inequities.

- \*\*Targeted prevention strategies:\*\* AI-driven preventive care pathways can be designed to target specific risk factors prevalent in underserved communities (e.g., higher rates of diabetes in certain racial groups) and recommend evidence-based interventions accordingly.

### Conclusion

Guideline modeling, when integrated with AI in clinical pathways, has the potential to transform healthcare by advancing health equity. By standardizing care, reducing bias, incorporating social determinants of health, and ensuring personalized and predictive interventions, AI can help ensure that healthcare is more inclusive and responsive to the needs of diverse populations. This approach not only improves the quality of care but also works toward closing the health disparities gap.

In clinical informatics, guideline modeling typically involves several axes to structure and represent clinical guidelines in ways that computers can interpret and apply to clinical pathways. Axis 1 (the "conceptual model") and Axis 3 (the "workflow model") are particularly significant in terms of how they can be leveraged to build clinical pathways that advance health equity.

### \*\*Axis 1: Conceptual Model\*\*

The conceptual model (Axis 1) represents the fundamental clinical concepts within the guidelines, including diseases, symptoms, treatments, risk factors, and their relationships. It provides the knowledge base for decision-making and helps translate clinical evidence into a usable format.

#### \*\*Leveraging Axis 1 for Health Equity\*\*

To advance health equity, the conceptual model must be designed to explicitly account for diverse patient populations, especially those historically underrepresented or underserved. Here’s how it can be done:

1. \*\*Incorporating Social Determinants of Health (SDOH)\*\*

- \*\*Enhancing the knowledge base:\*\* Axis 1 can be expanded to include not only medical conditions but also social determinants of health (SDOH) such as housing, food insecurity, education, and income levels, which significantly affect health outcomes. This ensures that clinical pathways built on these models consider both clinical and non-clinical factors that disproportionately impact marginalized communities.

- \*\*Personalizing risk assessments:\*\* When the conceptual model includes data on race, ethnicity, socioeconomic status, and geography, AI-powered clinical pathways can personalize care more accurately for different populations. For example, predictive models can flag high-risk patients based on environmental and social conditions that influence their health.

2. \*\*Addressing Population-Specific Risks and Conditions\*\*

- \*\*Contextualizing disease burden:\*\* Axis 1 should explicitly model diseases and health risks that are prevalent in specific demographic groups, such as higher rates of diabetes among certain racial groups or increased cardiovascular risks in economically disadvantaged populations. By including these considerations, guideline modeling can ensure that clinical pathways are sensitive to the health needs of all populations.

- \*\*Guidelines based on inclusive research:\*\* Axis 1 can prioritize the inclusion of clinical guidelines derived from studies that represent diverse populations. This mitigates the risk of applying guidelines that may not be fully applicable to underrepresented groups due to the homogeneity of research samples.

3. \*\*Health Equity Alerts in Decision-Making\*\*

- \*\*Equity-informed decision support:\*\* The conceptual model can be designed to trigger alerts or recommendations for additional support when equity-related factors are identified. For example, a pathway might recommend additional resources for a patient facing housing instability, or suggest modified treatment plans based on financial limitations that might hinder medication adherence.

### \*\*Axis 3: Workflow Model\*\*

The workflow model (Axis 3) focuses on how the clinical guidelines are operationalized within clinical settings. It represents how specific actions are carried out, including the sequence of tasks, roles of care providers, and the integration of tools like AI-driven decision support systems.

#### \*\*Leveraging Axis 3 for Health Equity\*\*

To advance health equity, the workflow model must ensure that clinical pathways are implemented in ways that do not perpetuate disparities and are flexible enough to address the needs of diverse populations.

1. \*\*Ensuring Equity in Clinical Workflow\*\*

- \*\*Integrated equity checks:\*\* Axis 3 can be used to incorporate checkpoints throughout the clinical workflow where equity considerations are explicitly assessed. For example, at each stage of care—diagnosis, treatment, follow-up—systems can prompt clinicians to review whether SDOH are being adequately addressed or if certain populations might need additional resources.

- \*\*Tailored intervention workflows:\*\* The workflow model can include branching paths that adapt the sequence of care based on the unique needs of patients. For instance, patients from lower-income backgrounds might be automatically linked to social services or community health resources as part of their care pathway, thus addressing systemic barriers to health equity.

2. \*\*Standardization of Equitable Practices Across Providers\*\*

- \*\*Protocol-driven equity:\*\* By standardizing workflows across clinicians and care settings, Axis 3 can reduce variability in care that often leads to disparities. Standardized workflows ensure that all patients, regardless of background, receive the same high-quality care, guided by evidence-based best practices that account for health equity.

- \*\*Minimizing bias through automated workflows:\*\* By automating certain decision points in the clinical workflow, such as selecting appropriate diagnostic tests or treatment plans, Axis 3 can reduce the impact of implicit biases that may arise in human decision-making. Automated workflows ensure that care is consistently applied according to guidelines, which can help eliminate discrepancies in how care is provided to different populations.

3. \*\*Adapting Workflows for Underserved Populations\*\*

- \*\*Flexible care pathways:\*\* Axis 3 can model workflows that are flexible enough to accommodate the unique needs of underserved populations. For instance, pathways can include options for telemedicine visits for patients in rural areas, or workflows that prioritize care navigation and community health worker support for patients facing language barriers or cultural differences.

- \*\*Resource allocation workflows:\*\* The workflow model can be built to identify and allocate additional resources for patients from marginalized groups. For example, if a workflow identifies a patient facing transportation barriers, it can trigger additional care coordination steps, such as scheduling in-home visits or connecting patients with transportation services.

4. \*\*Data Collection and Feedback Loops\*\*

- \*\*Monitoring disparities in real-time:\*\* Axis 3 can include steps for collecting and analyzing real-time data on patient outcomes stratified by race, ethnicity, gender, and socioeconomic status. This allows for continuous monitoring of whether certain groups are experiencing inequitable outcomes, enabling quick adjustments to workflows and care protocols.

- \*\*Outcome audits embedded in workflows:\*\* Routine audits can be integrated into clinical workflows to identify disparities in care delivery. These audits can prompt clinicians to review whether their decisions align with equitable care practices and provide recommendations for improvements.

### \*\*Conclusion\*\*

By leveraging Axis 1 (conceptual model) and Axis 3 (workflow model) in guideline modeling, clinical pathways can be built to actively promote health equity. Axis 1 ensures that the knowledge driving decision-making reflects the full diversity of patient populations, incorporating social determinants of health and addressing population-specific risks. Axis 3 ensures that these guidelines are operationalized in workflows that reduce variability, automate equity-conscious decisions, and provide flexible, personalized care for underserved populations. Together, these models help build pathways that close gaps in care and advance equitable health outcomes for all.

Workflow analysis and workflow re-engineering are critical tools in designing clinical pathways that promote health equity. Both processes focus on understanding and improving how healthcare services are delivered, ensuring that all patients, regardless of background, receive equitable care.

### 1. \*\*Workflow Analysis\*\*:

- \*\*Purpose\*\*: Workflow analysis examines the current processes within a healthcare system to identify bottlenecks, inefficiencies, or disparities in care delivery. It focuses on how tasks are performed, who performs them, and the flow of information.

- \*\*Application in Clinical Pathways\*\*: In the context of building clinical pathways that support health equity, workflow analysis can identify where inequalities arise in patient care. For example, this could be in the time it takes for patients from different demographics to receive a diagnosis, or differences in treatment based on socio-economic or racial backgrounds. By analyzing these processes, it becomes easier to pinpoint where disparities occur.

- \*\*Outcome for Health Equity\*\*: This analysis informs where systemic barriers to care exist, such as language barriers, cultural misunderstandings, or delays in access for underserved populations. Identifying these issues allows healthcare organizations to address them in the design of more equitable clinical pathways.

### 2. \*\*Workflow Re-engineering\*\*:

- \*\*Purpose\*\*: Workflow re-engineering involves redesigning current processes to make them more efficient, patient-centered, and equitable. It’s about restructuring the way care is delivered to eliminate inefficiencies and inequities.

- \*\*Application in Clinical Pathways\*\*: In building clinical pathways, workflow re-engineering helps create standardized, evidence-based processes that are accessible to all patients. For instance, re-engineering could involve creating decision points within pathways that consider social determinants of health (SDOH), such as housing status, income, or access to transportation. This would ensure that patients facing specific challenges are referred to additional resources or receive tailored care.

- \*\*Outcome for Health Equity\*\*: By restructuring workflows to incorporate health equity principles, organizations can ensure that all patients follow a clinical pathway designed to meet their unique needs. This can reduce gaps in care caused by social, economic, or racial disparities, making sure that care delivery is both uniform in quality and personalized where necessary.

### Integrating Both for Health Equity:

- \*\*Data-Driven Insights\*\*: Combining workflow analysis with re-engineering allows healthcare providers to use data on patient outcomes and experiences to continuously refine clinical pathways. These adjustments ensure that inequities identified through analysis are corrected in re-engineered processes.

- \*\*Community and Stakeholder Engagement\*\*: By involving patients and community stakeholders in both the analysis and re-engineering phases, healthcare organizations can ensure that pathways address the real-world challenges faced by underserved populations.

- \*\*Culturally Competent Care\*\*: Re-engineered workflows can embed practices such as culturally competent care and language services at key points within clinical pathways, ensuring that minority populations receive care tailored to their linguistic and cultural needs.

In summary, workflow analysis identifies existing disparities in care delivery, while workflow re-engineering rebuilds clinical pathways to ensure they are inclusive, efficient, and supportive of health equity. Together, they create systems where the care provided to patients is fair, accessible, and consistent across different demographics.

A screen shot of a diagram

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A diagram of a curve

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The enablers to healthcare professionals' use of research evidence in clinical practice, as identified by Squires et al. (2019), include:

1. \*\*Resource Access\*\* - Having adequate time and access to guidelines or documentation.

2. \*\*Work Structure\*\* - The arrangement of tasks, responsibilities, and resources within and between teams.

3. \*\*Patient Characteristics\*\* - Attributes of the patients under care that influence how evidence is applied.

4. \*\*Professional Role\*\* - The set of expectations associated with a specific clinical occupation that may support or hinder evidence use.

These factors were recognized as critical attributes affecting the implementation of research evidence in clinical settings.

The enablers of research evidence use in clinical practice identified by Squires et al. (2019)—resource access, work structure, patient characteristics, and professional role—are essential to the development of \*\*clinical pathways\*\* for standardized care delivery. Clinical pathways are structured, evidence-based plans that standardize treatment processes for specific patient populations to improve outcomes, enhance efficiency, and reduce variability in care. Here’s how these enablers contribute to clinical pathway development:

1. \*\*Resource Access\*\*: For a clinical pathway to be effectively implemented, clinicians need access to necessary resources, including time, evidence-based guidelines, and relevant tools. Access to these resources allows healthcare teams to follow structured steps without needing to gather resources on the go, ensuring consistent application of the pathway.

2. \*\*Work Structure\*\*: The organization of tasks, roles, and responsibilities within and across healthcare teams is central to developing and implementing clinical pathways. Pathways rely on a streamlined, efficient workflow to ensure that each step in the care process happens at the right time, by the right person, in the right way. Clear work structures support adherence to the pathway and make it easier to integrate standardized processes into routine care.

3. \*\*Patient Characteristics\*\*: Clinical pathways often need to be flexible to account for variations in patient demographics, clinical presentations, and comorbidities. Recognizing patient-specific needs allows pathways to be tailored without compromising their evidence-based structure, ensuring that care remains both personalized and standardized where applicable.

4. \*\*Professional Role\*\*: Healthcare providers' roles and expectations within clinical pathways must be well-defined. Implementation of clinical pathways depends on buy-in and adherence from diverse healthcare professionals, each playing a specific role. Understanding and aligning with these roles ensures that each professional understands their part in delivering standardized care, reducing variability in practice.

In summary, these enablers align with the goals of clinical pathways by addressing the practical, contextual, and professional factors that support consistent, evidence-based, and patient-centered care. Together, they provide a foundation for creating pathways that are feasible, scalable, and effective in improving care quality and efficiency.

Applying implementation science principles to the development and deployment of clinical pathways can significantly enhance their adoption, effectiveness, and sustainability. Here’s how key principles can be applied:

1. Engage stakeholders early and throughout the process

- Application: Involve clinicians, administrators, and patients early in the development of clinical pathways. Gather input on perceived barriers and facilitators to using the pathway, ensuring that it addresses real-world challenges.

- Example: Hold focus groups or workshops to understand the needs and expectations of different healthcare roles, which can guide pathway design and enhance buy-in.

2. Adapt the pathway to fit the local context

- Application: Customize the clinical pathway based on specific characteristics of the setting and population. This could involve adjusting for patient demographics, local resources, and institutional workflows.

- Example: In a resource-limited setting, the pathway may need to include alternative diagnostic tools or treatments that are more readily available.

3. Develop clear communication and training strategies

- Application: Educate staff on the pathway’s purpose, benefits, and steps, emphasizing how it improves patient outcomes. Use diverse training formats, such as in-person sessions, written guides, and e-learning, to reach all users effectively.

- Example: Incorporate simulation-based training or shadowing opportunities for staff to practice the pathway in a controlled environment, reinforcing both knowledge and confidence.

4. Optimize workflow integration

- Application: Conduct workflow analyses to identify where the pathway naturally fits and where adjustments are needed. This could involve rearranging tasks, redistributing responsibilities, or adding automated reminders within electronic health records (EHR).

- Example: Use process mapping to identify steps that can be automated or simplified, like including order sets in the EHR that align with the pathway’s recommendations.

5. Use pilot testing and iterative refinement

- Application: Start with small-scale pilots of the pathway in selected departments or patient groups, gathering feedback to refine the pathway before a full rollout.

- Example: After a pilot in one hospital unit, gather data on adherence, patient outcomes, and clinician satisfaction, and then adjust steps based on what worked and what didn’t.

6. Implement continuous monitoring and feedback loops

- Application: Establish metrics for pathway adherence and clinical outcomes, and create regular feedback loops for healthcare teams. This could include monthly reports, dashboards, or meetings to review progress and discuss challenges.

- Example: Use data to track key performance indicators (KPIs) like readmission rates or time-to-treatment. Regular feedback enables real-time adjustments and keeps teams engaged and accountable.

7. Address barriers through tailored strategies

- Application: Identify and address common barriers, such as time constraints or resource limitations, using strategies like role reassignment or resource reallocation to minimize disruptions.

- Example: If clinicians find the pathway adds time to their workload, consider simplifying documentation steps or adding support staff to handle non-clinical tasks, freeing up clinicians for direct patient care.

8. Cultivate a supportive organizational culture

- Application: Encourage an organizational culture that values standardized, evidence-based care through leadership support and by celebrating successes and adherence to the pathway.

- Example: Recognize and reward units or individuals who show high adherence to the pathway, creating positive reinforcement and modeling successful pathway use.

9. Ensure sustainability with policy and leadership support

- Application: Align clinical pathways with institutional policies and obtain backing from leadership to integrate pathways into the long-term operational strategy.

- Example: Embed the pathway as a standard operating procedure (SOP) and ensure it’s regularly updated, maintaining relevance and alignment with best practices.

By applying these implementation science principles, clinical pathways can be better integrated into everyday practice, increasing their chances of lasting impact and ultimately leading to more consistent, effective, and patient-centered care.

The development and implementation of clinical pathways rely increasingly on principles of artificial intelligence (AI) in healthcare. AI provides data-driven insights, predictive modeling, and automation that support evidence-based decision-making, improve workflow integration, and enhance pathway adherence. Here’s how key AI principles intersect with clinical pathway work:

1. Data collection and integration

AI supports the continuous collection, integration, and analysis of patient data from various sources, including electronic health records (EHRs), wearable devices, and diagnostic imaging. By synthesizing these data, AI can identify patterns and relevant clinical data points that inform pathway development, allowing pathways to reflect real-time, patient-specific needs.

2. Predictive analytics and risk stratification

Machine learning algorithms analyze historical patient data to predict outcomes, stratify patients by risk, and guide treatment decisions within clinical pathways. Predictive models can flag patients at risk for complications, alert providers to potential deviations from optimal care, and enable proactive interventions. This helps tailor clinical pathways more closely to individual patient needs and can improve outcomes.

3. Natural language processing (NLP) for knowledge extraction

NLP algorithms process large volumes of clinical literature, guidelines, and case notes, extracting relevant knowledge that helps keep clinical pathways up-to-date with the latest evidence and best practices. NLP also automates information extraction from clinical notes, ensuring pathways reflect current data and reducing the need for manual data entry.

4. Automated decision support

AI-based clinical decision support systems (CDSS) provide real-time recommendations within pathways, alerting providers to the next steps in care and potential complications based on patient data and pathway guidelines. This type of support reduces clinical variation and aligns care more closely with established protocols, facilitating consistent pathway adherence.

5. Personalization and adaptive pathways

AI allows for adaptive pathways that can adjust based on individual patient profiles, treatment responses, and contextual factors, such as comorbidities or lifestyle data. Personalized pathways ensure that standardized care aligns with unique patient needs, leveraging AI to determine when deviations from the standard pathway may be beneficial.

6. Workflow optimization and automation

AI can streamline tasks within clinical pathways by automating repetitive processes, such as data entry, scheduling, or lab order processing, which reduces clinician workload. AI can optimize pathway workflows by analyzing bottlenecks or inefficiencies, allowing for smoother integration into clinical routines and minimizing interruptions in patient care.

7. Continuous learning and pathway improvement

AI algorithms learn from new data and patient outcomes, enabling pathways to evolve and improve over time. This principle of continuous learning supports the iterative refinement of pathways, incorporating feedback and updated outcomes data to ensure that pathways reflect best practices and are responsive to emerging evidence.

8. Monitoring and compliance tracking

AI can track compliance with clinical pathways, providing insights on pathway adherence, variations, and outcomes. This enables healthcare organizations to identify areas for improvement, support clinicians in adhering to pathway guidelines, and measure the impact of pathways on patient outcomes, thus enhancing accountability and pathway effectiveness.

By leveraging AI, clinical pathways become more dynamic, evidence-based, and responsive to patient and system needs. AI-driven insights, real-time support, and data-driven adaptations enhance pathways' effectiveness, helping to standardize high-quality care while allowing for personalized patient management.

Clinical Pathways help move physicians from having knowledge to wisdom as part of the DIKW model.

Describe the Epic build informatic architecture and data flow mapping

Leverages human-in-the-loop concept to enhance patient safety

Clinical pathways are expert systems that the applications chat GPT/gen AI is applied to as part of machine learning

Yes, non-profit organizations (NPOs) can have copyrights, and they can also trademark their name, logo, and other intellectual property. Copyrights and trademarks are two of the most important types of intellectual property for NPOs.

Here are some things to know about copyrights for NPOs:

* **Ownership**

NPOs don't automatically own the copyright to works created by non-employees. To ensure ownership, the NPO should include a provision in agreements with volunteers, board members, and vendors.

* **Registration**

While copyright protection is automatic, registering a work with the U.S. Copyright Office is recommended. Registration is inexpensive, simple, and doesn't require legal counsel. It can help enforce copyright rights, and it's required to pursue statutory damages and attorneys' fees.

* **Licensing**

NPOs can license their intellectual property to generate income. For example, a nonprofit might license a curriculum created by an employee to another organization.

**Prompt Engineering Best Practices**

*Dr. Dong Han-Yao*

* Prompting: a method to help develop AI → personal and production prompting
* You can assign chatGPT a role through prompting → roles don’t matter in getting accurate answers
  + Also can assign chatGPT a tone and goal for its response

*Dr. Shivam Vedak*

* Advanced prompting techniques → research into this is low yield
* Three key points for prompting: few shot learning (FSL), chain of thought (COT), clear communication
  + Few shot learning
    - Giving some examples to ChatGPT to get better results
  + Thinking fast and slow with large language models (LLM)
    - System 1: fast unconscious automatic thinking → this is what LLMs do
    - System 2: slow conscious deliberate thinking → our goal
    - We can use chain of thought to get us there
  + Clear communication: taking a paragraph and turning it into 3-4 smaller concepts
* You can say “ask me clarifying questions” to ChatGPT to get better results
* Meta prompting: ask LLM to evaluate your prompt

In healthcare AI, addressing decision biases is essential to ensure equitable, accurate, and clinically effective outcomes. Several strategies are employed to mitigate these biases:

1. \*\*Diverse and representative data\*\*: AI models trained on diverse datasets that include varied patient demographics (such as age, gender, ethnicity, and socioeconomic status) can reduce biases that arise from underrepresentation of specific groups. Models trained on biased or unrepresentative data risk making inaccurate predictions or perpetuating disparities.

2. \*\*Bias auditing and fairness metrics\*\*: Regular auditing and the use of fairness metrics allow teams to assess where and how a model may be biased. Metrics such as demographic parity, equalized odds, and calibration across groups help reveal whether the model performs consistently across different patient populations.

3. \*\*Explainable AI\*\*: Developing explainable AI systems enables clinicians and researchers to understand how models make decisions. Techniques such as feature importance analysis, SHAP values, and LIME (Local Interpretable Model-agnostic Explanations) highlight which data points influence predictions, allowing users to detect and address potential biases.

4. \*\*Human-in-the-loop review\*\*: Involving clinicians or data scientists in the loop for reviewing model predictions helps catch potential biases before deployment. This iterative feedback process, where human experts validate model decisions, can be especially effective in clinical decision support systems where patient safety is paramount.

5. \*\*Regular updates and retraining\*\*: Because healthcare practices and populations evolve, AI models require retraining on current, relevant data to avoid outdated biases. Regular updates reduce biases from outdated medical practices or evolving patient demographics.

6. \*\*Transparent reporting and documentation\*\*: Transparent reporting on model development, including data sources, limitations, and performance metrics across different groups, helps build trust and allows stakeholders to understand and account for any biases present in the model.

7. \*\*Ethics and bias education\*\*: Educating AI developers and clinicians on the potential for bias in machine learning models is crucial. By fostering awareness, healthcare teams can proactively design models and processes with an understanding of the types of biases that can emerge and the ways they impact patient care.

Together, these strategies create a comprehensive approach to addressing biases in healthcare AI, working toward models that are fair, accurate, and useful for all patients.

**CarePathIQ**

**About**

CarePathIQ—*Democratizing Intelligent Pathways for Equitable, Patient-Centered Care*—is a pioneering nonprofit application that leverages AI-engineered clinical pathways to make equitable, patient-centered healthcare accessible to all. It aims to standardize care delivery and lessen physicians' cognitive load, ultimately enabling clinicians to spend more time at the bedside and enhance the quality and consistency of patient care.

CarePathIQ's mission is to lower healthcare costs, improve care quality, advance health equity, and increase patient satisfaction. The AI Portal

Education

**Education**

 CarePathIQ’s asynchronous video lecture series, "Development and Implementation of AI-Augmented Clinical Pathways to Advance Health Equity," empowers healthcare professionals to utilize clinical pathways as tools to streamline decision-making, reduce cognitive load, and ultimately increase the time available for bedside care. Through structured, evidence-based pathways, clinicians gain clear guidance on diagnostics, treatment, and disposition, which minimizes the mental demands of navigating complex care scenarios and promotes more consistent, high-quality patient care.

The curriculum is organized into modules that demonstrate the dual impact of pathways on both patient outcomes and clinician efficiency:

* **Module A: Foundations of Clinical Pathways** This module introduces the role of clinical pathways in creating standardized care processes that reduce variability and relieve clinicians’ cognitive load. Clinical pathways support clinicians by providing structured, step-by-step guidance, enabling them to focus more fully on patient interactions and bedside care rather than on extensive decision-making for routine cases.
* **Module B: AI and Bias Mitigation in Pathway Design** Participants learn about common cognitive biases, such as anchoring and availability biases, and how these can be reduced through AI-augmented pathways. By automating complex decision points, pathways help clinicians avoid mental shortcuts and ensure equitable care, all while reducing the burden of repetitive decision-making.
* **Module C: Practical Design and Implementation** In this module, clinicians are introduced to quality improvement techniques for pathway development, such as DMAIC (Define, Measure, Analyze, Improve, Control). Lectures highlight how well-designed pathways support clinicians by providing readily available, evidence-based treatment options, reducing time spent on protocol selection and allowing for greater attention to direct patient care.
* **Module D: Impact Assessment and Monitoring** Participants learn to evaluate the effectiveness of pathways in improving care quality, health equity, and clinical workflow. Pathways help streamline diagnostics and treatment, enabling clinicians to shift their cognitive resources from logistical tasks to hands-on, compassionate patient care.

Each module includes case studies, quizzes, and application exercises, allowing clinicians to directly experience how structured pathways decrease cognitive load and optimize their capacity for bedside care. This curriculum enables clinicians to become adept at using clinical pathways to support efficient, high-quality, and equitable patient care, enhancing their bedside role.

**Implementation Toolkit**

 The Implementation Toolkit provides templates, checklists, and resources to facilitate the practical application of clinical pathways.

**AI Portal**

Accessible exclusively to healthcare professionals with institutional emails, the AI Portal offers the following resources:

* **Pathway Design**: Facilitates pathway alignment with evidence-based practice by guiding users through structured input fields and stepwise prompts.
* **Bias Mitigation**: Identifies potential decision biases (e.g., anchoring, confirmation, and implicit biases) in clinical pathway design and provides customized guidance on bias-reducing strategies.
* **CDS Wiremap**: Visualization of pathway workflow, showing each process and decision point in the pathway as it progresses from patient presentation to disposition.
* **References**: A curated list of peer-reviewed articles, clinical guidelines (e.g., Milliman Care Guidelines, InterQual Criteria, ACEP Clinical Policies), and other evidence-based resources supporting each pathway component.

**Pathway Design**

Using boolean logic, clinicians can generate a clinical pathway outline for conditions by referencing established guidelines and evidence-based practices. This outline details:

* **Evaluation, Risk Stratification, Diagnostics, Treatment, and Disposition**: Pathways specify lab and radiology tests, indications, medication types, dosages, and titrations, as well as emergent consultations. They also provide criteria for appropriate disposition levels, including discharge, observation, inpatient, or intensive critical care.
* **Customizable Outline**: Users can refine pathways by prompting, “How can I give you a more helpful response?”

**Bias Mitigation**

The AI Portal’s bias mitigation section identifies common decision biases (e.g., anchoring, availability, stereotyping) and suggests mitigation strategies for each, ensuring pathways support equitable decision-making. Users can revise pathways with minimized biases, using prompts to enhance feedback.

**Wiremap**

Each clinical pathway is presented in a wiremap format, displaying the workflow with:

* **Start and End Nodes**: Represented by green ovals, indicating the pathway from initial patient presentation to disposition.
* **Processes**: Shown as yellow rectangular boxes for steps like lab ordering and treatments.
* **Decision Trees**: Illustrated as light red triangles for decision points based on risk stratification, treatment response, or abnormal test results.

**References**

The AI Portal provides a comprehensive list of references supporting each pathway, ensuring adherence to evidence-based practices through guidelines like the Milliman Care Guidelines, InterQual Criteria, ACEP Clinical Policies, and relevant peer-reviewed journals.

**Board of Directors**

Michelle Lin, Arjun Venkatesh, Robert Rohrbaugh, Brendan Carr, Nicholas Gavin, Kelly Bookman, Jennifer Wiler, Richard Zane, Dowin Boatright, Nicholas Genes, Brian Garibaldi (and other SBM members?)

About (I am CEO of the medical education nonprofit organization)

Education

Implementation Toolkit (?accessible only by healthcare professionals with institutional emails; see thumbnails but can’t download without an account)

AI Portal (accessible only by healthcare professionals with institutional emails)

* Pathway Design
* Bias Mitigation
* CDS Wiremap
* References

PATHWAY OUTLINE

Apply boolean logic to generate a clinical pathway outline based on Milliman Care Guidelines, InterQual Criteria, American College of Emergency Physicians (ACEP) Clinical Policies, and peer-reviewed research with moderate or high-GRADE evidence for patients presenting to the emergency department with \*\*\*condition\*\*\* that defines inclusion criteria, identifies key processes and risk stratification schema, specifies diagnostics, outlines treatment options, determines disposition criteria, defines monitoring intervals, finalize decision points and defines measures of success.

*\*\*\*User can make modifications using the chat gpt plugin before going on to the next step\*\*\*: - chapt gpt prompt: “How can I give you a more helpful response?”*

BIAS MITIGATION

List the potential decision biases in this clinical pathway and identify mitigation strategies for biases in pathway design.Examples of decision bias are anchoring bias, confirmation bias, availability bias, implicit bias, framing bias, stereotyping bias, and overconfidence bias.

Rewrite this clinical pathway after minimizing the impact of the decision biases identified.

*\*\*\*User can make modifications using the chat gpt plugin before going on to the next step\*\*\**

WIREMAP

Create a table representing a flowchart to accurately reflect inclusion criteria, identify key processes and risk stratification schema, specify diagnostics, outline treatment options, determine disposition criteria, define monitoring intervals, finalize decision points, and define measures of success. A diamond box represents a decision point in a flowchart. The diamond box has one input and two labeled binary (yes/no) outputs to indicate a decision. A rectangular box is used to indicate tasks or activities being performed. Examples of tasks or activities are diagnostics or treatment. At the same time, an oval is the terminal node, used to indicate the start (input) or end (output) of a process. The start node is “patient with \*\*\*,” and an example of an end node is a specific disposition. Examples of decision points are risk stratification scores and disposition criteria.

*\*\*\*User can make modifications using the chat gpt plugin before going on to the next step\*\*\**

REFERENCES

* List the references supporting this evidence-based clinical pathway.

For IRB-approved QI evaluation use on DVT/PE pathway and observation service pathways by me NOT on AI portal/website, with recognition of the application of Human-in-the-Loop (HITL) Learning to large language models and generative AI

“Patient-Centered Communication” (have PFAC review it as part of the participatory quality improvement design)

* If I am the patient, explain to me what disposition of \*\*\* means in this clinical pathway.
* If I am the patient, explain to me the risks associated with leaving the emergency department against medical advice in this clinical pathway.
* If I am the patient, engage in shared decision-making on completing disposition \*\*\* in this clinical pathway.
* If I am the patient, describe the strict return precautions I should take after discharge from the emergency department.

\*\*\*patient serves as end-user and gives feedback on more friendly or more easy to understand; voting on different versions\*\*\*

For IRB-approved QI evaluation use on observation service pathways by me NOT on AI portal/website, with recognition of the application of large language models and generative

Human-in-the-Loop (HITL) Learning to Optimize Clinical Decision Support: Pathway is updated with input from team feedback after each of the following user tasks

* Define Inclusion Criteria
* Identify Key Processes
* Risk Stratification Points
* Specify Diagnostics
* Outline Treatment Options
* Determine Disposition Criteria
* Define Monitoring Intervals
* Finalize Decision Points
* Define Measures of Success

“Change Management”

* use ChatGPT or another LLM to analyze the written transcripts of the Zoom meetings for each clinical pathway meeting to identify effective communication, negotiation, and leadership strategies employed
* can compare observation pathways and the impact of the strategies employed on pathway design efficiency (ie. less time to go live) and effectiveness (based on evaluation report)

INDEPENDENTLY (not explicitly mentioned in any IRB)

“Clinical Documentation Integrity” -> impact of pathways with built-in dot phrases and structured ICD-10 codes on revenue cycle management, such as by increasing observation service-related charge capture, billing, and collections.

* Give me an example of high-complexity medical decision-making documentation for a CPT code of 99285 for a patient with a disposition of \*\*\* in this clinical pathway, based on the American Medical Association (AMA) Emergency Department (ED) Evaluation and Management (E/M) coding guidelines.
* Based on National Center for Health Statistics (NCHS) guidelines, what is the ICD-10 code for a patient with disposition \*\*\* in this clinical pathway?

“Staff Training & Compliance”

* Generate a high-yield, just-in-time staff training document. Include the purpose, underlying scientific evidence, and intended impact on quality, efficiency, and equity of care delivered through the pathway. Describe staff roles and responsibilities. Include an assessment of 4-5 multiple choice questions of staff’s understanding of the workflow for this specific clinical pathway. The target stakeholder audience is \*\*\*
* NOTE: If a staff member doesn’t follow or deviates from the pathway, they must take the assessment as a first warning.
* Can assess the impact of staff compliance with training (ie. peak modules for people who don’t attend a real-time session such as a faculty meeting, attestation surveys for those who do attend a real-time session) for different observation pathways on process and outcome measures

Incorporate into a larger website that highlights projects leveraging ai augmented care pathways with short video describing design and impact and text below with heading learn more and subheadings publications, presentations, and podcasts & press

* Unified Communications
* Vulnerable Populations & Care Transitions
  + - Observation Medicine Service
    - Post-Discharge Follow-Up Care (including for patients with limited English proficiency and limited digital literacy)
    - Geriatric Emergency Medicine Service
    - ? Behavioral Health Emergencies (Psych ED – Medical ED)