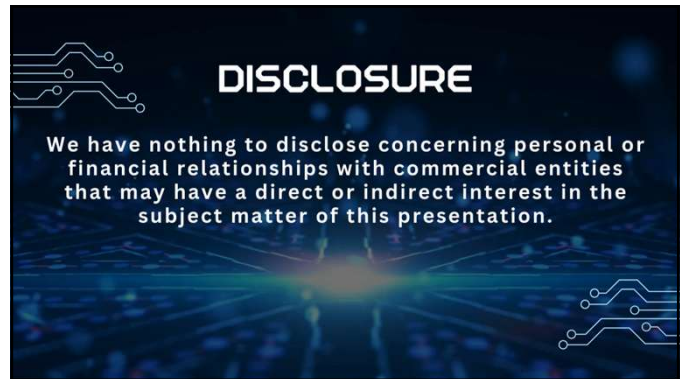
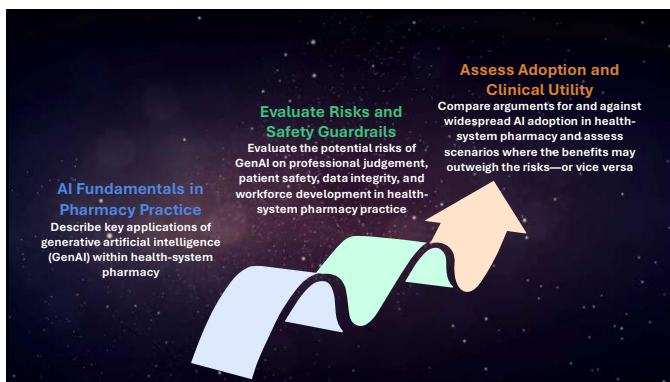




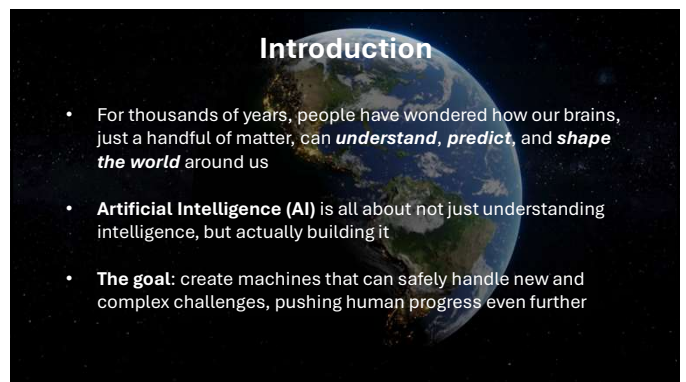
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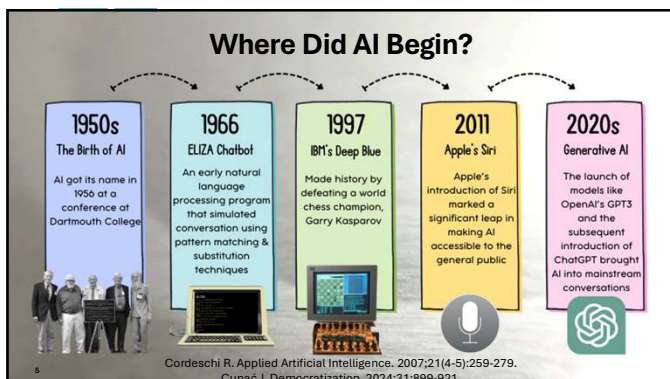
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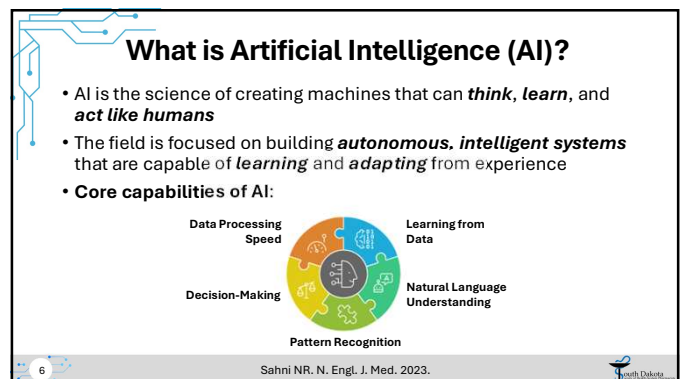
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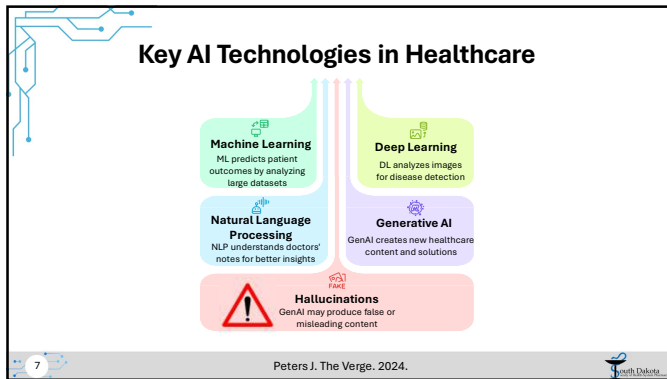
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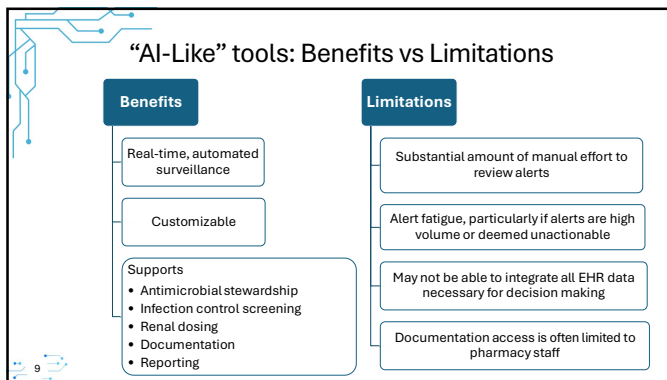


7

Brief History of “Artificial Intelligence-Like” Tools in Health-System Pharmacy

- Rules-based clinical surveillance and decision support
- Interfaced with EHRs and generated alerts based on rules
- Predate machine-learning tools but were foundational in pharmacy informatics

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What is Machine Learning (ML)?

- A specialized field within AI focused on building computational “machines” that automate complex **decision-making processes**
- Utilizes sophisticated **mathematical models** to find patterns in data
- Core concepts are rooted in **statistics, probability theory, and computer science**

Davenport T. Future Healthc J. 2019;6(2):94-98.

10

How Does a Machine “Learn”?

- The machine is given a training set, examples with correct answers
- It searches for patterns and builds a decision rule to separate different groups (for example, separating “disease” vs. “no disease”)
- The algorithm then tweaks itself to make as few mistakes as possible on what it’s learned

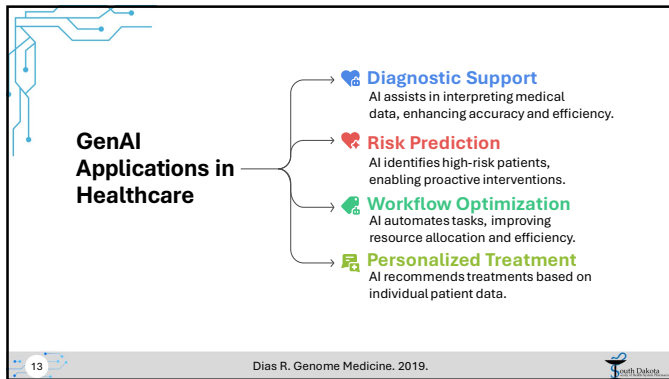
11

A New Frontier: Generative AI (GenAI)

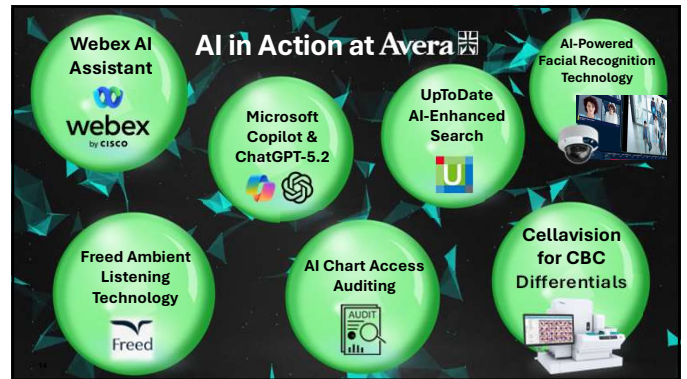
- **Traditional AI (Discriminative): The Analyst**
 - Learns from data to **recognize patterns, classify information, and make predictions**
 - Prompt example: “Based on this CT scan, is there evidence of a tumor?”
- **Generative AI (GenAI): The Creator**
 - Learns the underlying structure of data to **generate new content** like text, summaries, or images/videos
 - Prompt example: “Based on this patient conversation, draft a clinical note.”

Davenport T. Future Healthc J. 2019;6(2):94-98.

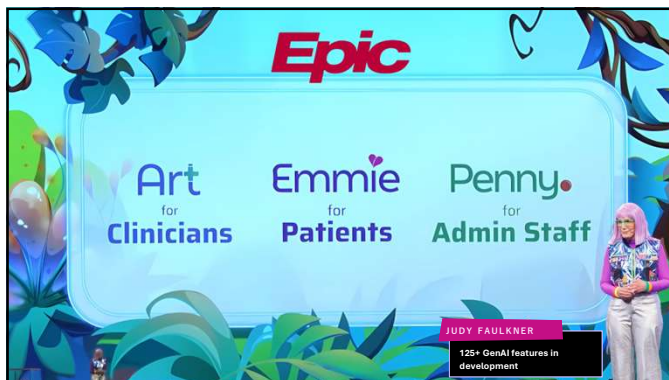
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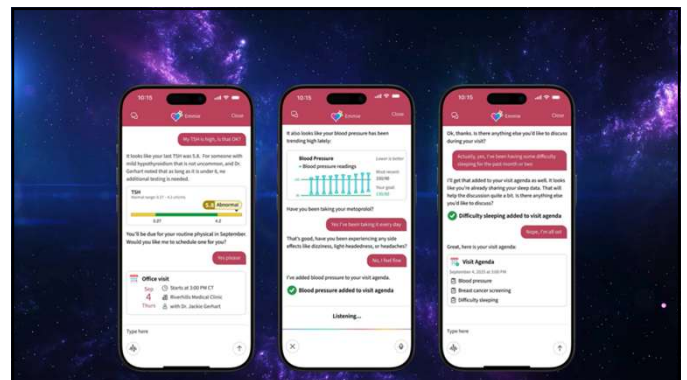
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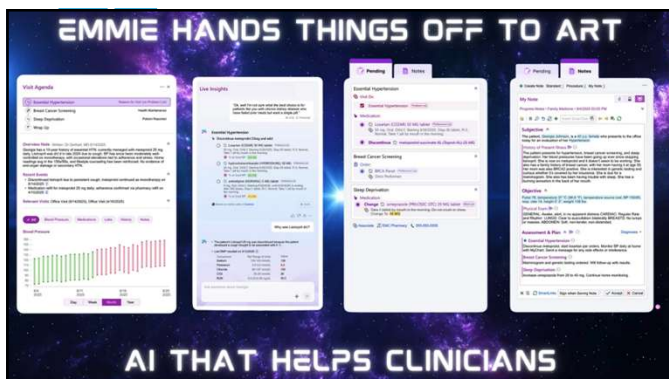
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Why GenAI in Pharmacy?

- Health-system pharmacy requires rapid, high-volume, high-stakes decision-making
- Increasing medication complexity and workforce shortages
- Administrative burden limits direct patient care time
- GenAI offers scalable clinical, operational, and educational support
- Debate centers on safety, governance, and professional oversight

Li X. J Med Internet Res. 2024.
Nelson SD. AJHP. 2020.

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Key Application Domains in Health-System Pharmacy

1. Drug information retrieval & literature synthesis
2. Medication order review & clinical decision support
3. Patient and staff education & communication
4. Administrative workflow optimization
5. Research & quality improvement support

- **Goal:** Improve medication safety, efficiency, and access to expertise

Ranchon F. Int J Med Inform. 2023.
Bedi S. JAMA. 2025.
Sahni NR. N Engl J Med. 2023.

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Drug Information Services	Medication Order Review & CDSS Support
• Rapid synthesis of medication literature • Answers clinical queries in seconds • Summarizes guidelines & emerging evidence	• Identifies drug-drug interactions • Assists with renal/hepatic dosing adjustments • Flags allergy and contraindication concerns • Supports pharmaceutical care planning

Frazer A. AJHP. 2025.
Li X. J Med Internet Res. 2024.
Nelson SD. AJHP. 2020.
Ranchon F. Int J Med Inform. 2023.

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Patient Education & Communication	Administrative & Workflow Optimization
• Generates medication counseling materials • Drafts discharge instructions • Translates complex information into patient-friendly language • Supports multilingual communication	• Prior authorization drafting • Documentation support • Billing code generation • Literature review for formulary decisions • Care coordination & scheduling assistance

Bedi S, et al. JAMA. 2025.
Sahni NR, et al. N Engl J Med. 2023.

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That sound great! But what about...

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Professional Judgement

- AI tools are very attractive for multiple reasons
- Just because it LOOKS good doesn't mean it IS good
- Studies suggest output accuracy may be impacted by the complexity of the query/question^{1,2}
 - Responses may be improved with more detailed prompts
- GenAI tools are "people pleasers" and want to provide an answer
 - May fabricate answers and references at times

¹Andrikyan W. BMJ Qual Saf. 2025.
²Munir F. J Pharm Pract. 2025.

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Example: AI use for Drug Information

Artificial intelligence for drug information: Evaluating its use in real-world pharmacy practice

Authors: Allison Frazer, BS (PharmD student), Department of Pharmacy Services, Michigan Medicine, Ann Arbor, MI, and University of Michigan College of Pharmacy, Ann Arbor, MI, USA; Emily Vance, PharmD, BCPS, Department of Pharmacy Services, Michigan Medicine, Ann Arbor, MI, and University of Michigan College of Pharmacy, Ann Arbor, MI, USA; Kevin M. Durant, PharmD, Department of Pharmacy Services, Michigan Medicine, Ann Arbor, MI, and University of Michigan College of Pharmacy, Ann Arbor, MI, USA.

Purpose: Artificial intelligence (AI) is a rapidly growing field within healthcare and is quickly becoming a staple resource for pharmacists for drug information (DI). The primary aim of this study is to determine the accuracy of 2 common AI tools in answering DI questions compared to the accuracy of information provided by University of Michigan Health (UMH) DI pharmacists.

Summary: A sample of 300 questions answered by the UMH DI service from July 2022 to June 2023 were included in this evaluation. Each DI query was condensed into a single question for input into each of 2 AI chatbot services: OpenAI's ChatGPT and Google's Gemini. Each question was entered as a new conversation in the AI tools, and initial responses were recorded along with any follow-up responses with references. After all questions were answered, the accuracy of each response and quality of references were adjudicated on a 3-point scale. ChatGPT and Gemini were both completely accurate, with reliable references provided 19% of the time. Fifteen percent of answers by ChatGPT were completely inaccurate and included false/unreliable references, while 5% of Gemini's answers were categorized as such. The remaining questions (86% for ChatGPT and 76% for Gemini) contained partially correct responses and/or incomplete resources.

Frazer A. Am J Health-Syst Pharm. 2025.

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Frazer, et. al.

- Sample of 300 drug information questions answered by two drug information service pharmacists (July 2022 – June 2023)
- Input into ChatGPT-4o and Gemini 1.0 (June 14 – July 10, 2024)
- Answers compared to documented responses from DI pharmacists
- AI responses adjudicated for accuracy and reference quality on a 3-point scale.
 - Completely accurate (3), partially accurate (2), completely inaccurate (1)
 - Completely reliable (3), partially reliable (2), completely unreliable (1)

Frazer A. Am J Health-Syst Pharm. 2025.

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DESCRIPTIVE REPORT

EVALUATION OF AI FOR DRUG INFORMATION QUESTIONS

Table 1. Accuracy of AI Responses and Reliability of References Provided*

	ChatGPT (N = 300)	Gemini (N = 300)
Answer accuracy score		
1	80 (26.7)	56 (18.7)
2	90 (30)	139 (46.3)
3	130 (43.3)	105 (35)
Mean score	2.17	2.16
Reference reliability score		
1	82 (27.3)	31 (10.3)
2	121 (40.3)	158 (52.7)
3	97 (32.3)	111 (37)
Mean score	2.05	2.27

Abbreviation: AI, artificial intelligence.
*All data are No. (%) of responses unless indicated otherwise.

Frazer A. Am J Health-Syst Pharm. 2025.

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Patient Safety

- AI tools have the potential to improve safety in multiple ways
- Federal government is "hands off" with specific AI regulation
- Who is responsible when GenAI is associated with an error?
 - AI tool?
 - Provider?
 - Health-System?

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Data Integrity

- AI use in healthcare without appropriate guardrails and vigilance may be risky
- If you place protected health information into a tool, where does it go? Do you know? How do you know?

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Workforce Development

- Are pharmacists ready for this?
- How do we prepare pharmacists and pharmacy students for this environment? What are our obligations?
 - AI literacy?
 - AI competency?
 - Ethical considerations?

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Arguments FOR Adoption

1. Improved medication safety detection
2. Rapid literature synthesis
3. Increased access in resource-limited settings
4. Reduced administrative burden

Core Argument: AI augments (not replaces) pharmacists!

Li X. J Med Internet Res. 2024.
Nelson SD. AJHP. 2020.
Mouhsen K. Int J Med Inform. 2024.
Reddy S. Implementation Science. 2024.

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Arguments AGAINST Adoption

1. Inaccurate outputs combined with loss of critical thinking
2. Patient safety concerns and limited regulatory oversight
3. Ethical concerns

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Risk-Benefit by Scenario

Benefits Likely Outweigh Risks:

- Administrative tasks
- Literature search & synthesis (with review)
- Patient education drafts
- Workflow optimization

Risks Likely Outweigh Benefits:

- Autonomous order verification and/or documentation
- High-risk medication dosing without oversight
- Sole-source drug information without clinical judgement/verification

Frazer A. Am J Health-Syst Pharm. 2025.
Howell MD. BMJ Qual Saf. 2024.
Bedi S. JAMA. 2025.
Maddox TM. N Engl J Med. 2025.

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Responsible Integration Model

AI Output → Pharmacist Verification → Clinical Decision

- Documented validation
- Transparent source checking
- Ongoing performance monitoring
- Defined scope of use

Frazer A. Am J Health-Syst Pharm. 2025.
Howell MD. BMJ Qual Saf. 2024.
Wachter RM. JAMA. 2024.

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You might be wondering: Is the pharmacist's role secure in the age of AI, or is it at risk?

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Top 40 Occupations With Highest AI Applicability Score

Job Title (Abbrev.)	Coverage	Cyphits	Scope	Score	Employment
Interpreters and Translators	0.98	0.88	0.77	0.49	51,343
Historians	0.91	0.85	0.56	0.48	3,048
Passenger Attendants	0.80	0.88	0.62	0.47	20,148
Sales Representative of Services	0.84	0.90	0.57	0.46	1,122,020
Writers and Authors	0.85	0.84	0.60	0.45	49,429
Customer Service Representatives	0.72	0.90	0.59	0.44	2,358,710
CNC Tool Programmers	0.90	0.87	0.53	0.44	28,630
Telephone Operators	0.80	0.86	0.57	0.42	4,600
Ticket Agents and Travel Clerks	0.71	0.90	0.56	0.41	119,270
Broadcast Announcers and Radio DJs	0.74	0.84	0.60	0.41	25,050
Bookkeeping Clerks	0.74	0.89	0.57	0.41	48,060
Farm and Home Management Educators	0.77	0.91	0.55	0.41	8,110
Telemarketers	0.66	0.89	0.60	0.40	81,240
Couriers	0.70	0.88	0.56	0.40	41,020
Political Scientists	0.77	0.87	0.53	0.39	5,590
News Analysts, Reporters, Journalists	0.81	0.81	0.56	0.39	43,020
Mathematicians	0.91	0.74	0.54	0.39	2,220
Technical Writers	0.83	0.82	0.54	0.38	47,970
Foodhandlers and Prep Workers	0.91	0.86	0.49	0.38	5,400
Hosts and Hostesses	0.69	0.90	0.57	0.37	425,020
Editors	0.78	0.82	0.54	0.37	95,700
Business Teachers, Postsecondary	0.70	0.90	0.52	0.37	82,980
Public Relations Specialists	0.63	0.90	0.60	0.36	275,540
Demonstrators and Product Promoters	0.64	0.88	0.53	0.36	50,740
Advertising Sales Agents	0.66	0.90	0.53	0.36	108,140
New Accounts Clerks	0.72	0.87	0.51	0.36	41,180
Statistical Assistants	0.85	0.84	0.49	0.36	7,290
Counter and Retail Clerks	0.62	0.90	0.52	0.36	200,340
Data Scientists	0.77	0.86	0.51	0.36	192,710
Personal Financial Advisors	0.69	0.88	0.52	0.35	272,140
Archivists	0.66	0.88	0.49	0.35	7,150
Economics Teachers, Postsecondary	0.68	0.90	0.51	0.35	12,210
Web Developers	0.73	0.86	0.51	0.35	85,250
Management Analysts	0.68	0.90	0.54	0.35	838,140
Geographers	0.77	0.83	0.48	0.35	1,460
Modelers	0.64	0.89	0.53	0.35	3,090
Market Research Analysts	0.71	0.90	0.52	0.35	846,210
Public Safety Telecommunicators	0.66	0.88	0.53	0.35	97,820
Software Operators	0.65	0.90	0.52	0.35	43,240
Library Science Teachers, Postsecondary	0.65	0.90	0.51	0.34	4,220

Tomlinson K. Microsoft. arXiv. 2025.

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Job Title (Abbrev.)	Coverage	Cumulative	Score	Empl.
Phlebotomists	0.06	0.95	0.29	0.03
Nursing Assistants	0.07	0.95	0.34	0.03
Hazardous Materials Removal Workers	0.04	0.95	0.35	0.03
Hipsters, Painters, Plasterers, ...	0.04	0.96	0.38	0.03
Engravers	0.07	0.95	0.22	0.03
Plant and System Operators, All Other	0.05	0.93	0.28	0.03
Oral and Maxillofacial Surgeons	0.05	0.89	0.34	0.03
Automotive Glass Installers and Repairers	0.01	0.93	0.34	0.03
Ship Engineers	0.05	0.92	0.29	0.03
Tire Repairers and Changers	0.04	0.95	0.35	0.02
Prosthodontists	0.10	0.90	0.29	0.02
Hipsters Production Workers	0.04	0.93	0.36	0.02
Highway Maintenance Workers	0.05	0.96	0.32	0.02
Medical Equipment Preparers	0.04	0.96	0.31	0.02
Packaging and Filling Machine Op.	0.04	0.91	0.29	0.02
Machine Feeders and Offenders	0.05	0.89	0.36	0.02
Dishwashers	0.03	0.95	0.30	0.02
Coastal Masons and Concrete Finishers	0.03	0.92	0.39	0.01
Supervisors of Firefighters	0.04	0.88	0.39	0.01
Industrial Truck and Tractor Operators	0.03	0.94	0.29	0.01
Ophthalmic Medical Technicians	0.04	0.89	0.33	0.01
Massage Therapists	0.10	0.91	0.32	0.01
Surgical Assistants	0.03	0.78	0.29	0.01
Tire Builders	0.03	0.93	0.40	0.01
Hipsters Roadies	0.02	0.94	0.27	0.01
Gas Compressor and Gas Pumping Station Op.	0.01	0.96	0.47	0.01
Roadies	0.02	0.94	0.38	0.01
Remediation, Oil and Gas	0.01	0.95	0.39	0.01
Molds and Remodeling Cleaners	0.02	0.94	0.34	0.01
Paving, Surfacing, and Tamping Equipment Op.	0.01	0.96	0.29	0.01
Lifting Equipment Operators	0.01	0.95	0.36	0.01
Motorboat Operators	0.01	0.93	0.39	0.00
Orderlies	0.00	0.76	0.18	0.00
Prior Sanders and Finishers	0.00	0.94	0.34	0.00
Pile Driver Operators	0.00	0.98	0.24	0.00
Rail-Track Laying and Maintenance Equip. Op.	0.00	0.96	0.27	0.00
Foundry Mold and Coremakers	0.00	0.95	0.36	0.00
Water Treatment Plant and System Op.	0.00	0.92	0.44	0.00
Bridge and Lock Tenders	0.00	0.93	0.39	0.00
Dredge Operators	0.00	0.90	0.37	0.00

Tomlinson K. Microsoft. arXiv. 2025.

What does this mean for us?

- Our profession is uniquely positioned, neither highly vulnerable nor fully insulated from AI's impact
- Some risk exists as AI evolves and automates more tasks
- **Significant opportunity:**
 1. Leverage AI to enhance daily work and patient care
 2. Increase our value as clinical pharmacists by focusing on complex decision-making
 3. Automate routine tasks, freeing up time for higher-level clinical work
 4. Stay at the forefront of healthcare innovation

Ravi P. American Journal of Health-System Pharmacy. 2025.

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South Dakota
ANY QUESTIONS?