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Phenomenological Assessment of Integrative Medicine Decision-making and the Utility of Predictive and Prescriptive Analytics Tools

Osie Gaines

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PHENOMENOLOGICAL ASSESSMENT OF INTEGRATIVE MEDICINE DECISION-MAKING AND THE UTILITY OF PREDICTIVE AND PRESCRIPTIVE ANALYTICS TOOLS

by

Osie Lee Gaines, III

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

Of

Doctor of Business Administration

In the Robinson College of Business

Of

Georgia State University

GEORGIA STATE UNIVERSITY

ROBINSON COLLEGE OF BUSINESS

2021

ACCEPTANCE

This dissertation was prepared under the direction of the *OSIE LEE GAINES, III* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Business Administration in the J. Mack Robinson College of Business of Georgia State University.

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ACKNOWLEDGEMENTS

I am Blessed to have a supportive wife. Michelle, thank you for believing in me, keeping me motivated, and sharing survival tips from your own PhD journey. Your encouragement and willingness to maintain our household during the busy seasons of this Doctor of Business Administration process will be rewarded in many ways, across many generations.

My advisor, Dr. Carol Saunders, deserves a garden of fresh flowers twisted into bountiful bouquets. Thank you, Carol, for demanding excellence and academic rigor throughout this doctoral process. I appreciate your ability to improve my academic writing ability while supporting my futurism, creativity, and overall vision.

Finally, I would like to thank all my ancestors and loved ones who prayed for this moment of achievement. God is good!

“Man, lucky me,
I was diagnosed with a heart disease at nineteen
Could barely stand on my feet
Doctor said they had to cut it open, put a pacemaker on it to put it back on beat
'Til my mama took me to holistic doctors and they prescribed me magnesium for two weeks
Went back to the regular doctors and they said,
‘Huh, damn, looks like we don't need to proceed,’
That's how I know that Western medicine’s weak.
Man, lucky me.”

Big Sean - “Lucky Me”

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LIST OF ABBREVIATIONS

1 AI-Artificial Intelligence
2 AIMDSS-Artificial Intelligence-Based Medical Diagnosis Support System
3 CAM-Complimentary & Alternative Medicine
4 CCPA- California Consumer Privacy Act
5 CMS- Centers for Medicare & Medicaid Services
6 DC-Doctor of Chiropractic
7 DNP-Doctor Nurse Practitioner
8 EHR-Electronic Health Records
9 EMR-Electronic Medical Records
10 EOU-Ease of Use
11 FDA-U.S. Food and Drug Administration
12 FHIR-Fast Healthcare Interoperability Resources
13 FFTTF-Future-Focused Task-Technology Theory
14 GDPR- General Data Protection Regulation
15 GSS-Group Support Systems
16 HICP-High Impact Chronic Pain
17 HIPAA-Health Insurance Portability and Accountability Act
18 IM-Integrative Medicine
19 IS-Information Systems
20 MD-Medical Doctor
21 MDM-Medical Decision-Making
22 ML-Machine Learning
23 ND-Naturopathic Doctor
24 NM-Naturopathic Medicine
25 PA-Physician Assistant
26 PII-Personally Identifiable Information
27 PPA-Predictive & Prescriptive Analytics
28 PRO-Patient Reported Outcomes
29 QOL-Quality of Life
30 SaaS-Software as a Service
31 SOAP-Subjective, Objective, Assessment and Plan
32 TTF-Task-Technology Fit
33 TTM-Task-Technology Misfit
34 UE-User Experience
35 WHO-World Health Organization

ABSTRACT

PHENOMENOLOGICAL ASSESSMENT OF INTEGRATIVE MEDICINE DECISION-MAKING AND THE UTILITY OF PREDICTIVE AND PRESCRIPTIVE ANALYTICS TOOLS

By

Osie Lee Gaines, III

July 2021

Chair: Carol Saunders
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The U.S. Healthcare system is struggling to manage the burden of chronic disease, racial and socio-economic disparities, and the debilitating impact of the current global pandemic caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). More patients need alternatives to allopathic or "Western" medicine focused on fighting disease with mechanism, pharmaceuticals, and invasive measures. They are seeking Integrative Medicine which focuses on health and healing, emphasizing the centrality of the patient-physician relationship. In addition to providing the best conventional care, IM focuses on preventive maintenance, wellness, improved behaviors, and a holistic care plan.

This qualitative research assessed whether predictive and prescriptive analytics (artificial intelligence tools that predict patient outcomes and recommend treatments, interventions, and medications) supports the decision-making processes of IM practitioners who treat patients suffering from chronic pain. PPA was used in a few U.S. hospitals but was not widely available for IM practitioners at the time of this research. Phenomenological interviews showed doctors benefit from technology that aggregates data, providing a clear patient snapshot. PPA exposed historical information that doctors often miss. However, current systems lacked the design to manage individualized, holistic care focused on the mind, body, and spirit.

Using the Future-Focused Task-Technology Fit theory, the research suggested PPA could actually do more harm than good in its current state. Future technology must be patient-focused and designed with a better understanding of the IM task and group characteristics (e.g., the unique way providers practice medicine) to reduce algorithm aversion and increase adoption. In the ideal future state, PPA will surface healthcare Big Data from multiple sources, support communication and collaboration across the patient's support system and community of care, and track the various objective and subjective factors contributing to the path to wellness.

INDEX WORDS: Artificial Intelligence, Future-Focused Task-Technology Fit Theory, Healthcare Innovation, Integrative Medicine, Phenomenological Research, Predictive and Prescriptive Analytics

I INTRODUCTION

I.1 U.S. Healthcare System in Crisis

In 2021, the U.S. Healthcare system continued to struggle with the impact of chronic disease, the unfortunate reality of racial and socio-economic disparities (including limited access to care and poorer outcomes for underrepresented populations), and the uncontrolled cost of care. The United States ranked 20th in the "Overall RCII" ranking for countries across Governance, Economics, Operations, and Society variables. However, when compared to all countries for Health the U.S. dropped to 32nd with the worst overall scores for substance abuse (*Robinson Country Intelligence Index, Georgia State University*, 2020).

The debilitating effects of the 2020-2021 global pandemic caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) exposed gaps in the U.S. Public Health infrastructure and epidemiological/surveillance mechanisms (e.g., tracking and tracing Covid-positive people). The U.S. had a delayed and lackluster response to the epidemic which led to 33.7 million confirmed cases and 605,000 deaths by July 1, 2021 ("U.S. Map," 2021). American families and businesses felt the resultant strain. State and local governments imposed different flavors of stay-at-home mandates; requirements about social distancing, wearing masks and taking temperatures; and either asked certain businesses (e.g., bars, restaurants, concert halls, etc.) to close down for periods of time or meet safety requirements to stay open and avoid fines. Essential workers like physicians, nurses, and medical laboratory professionals took risks to provide services with the threat of potential infection; potentially with limited access to adequate personal protective equipment.

Non-essential workers who were fortunate enough not to lose their jobs, elementary schoolers, and college students accepted a new reality of virtual and remote work and learning;

operating away from their usual social settings, isolated in their home environments, using web-based collaboration tools to communicate. The pain of isolation, loss of loved ones, and lack of visibility into an uncertain future added a strain on the mental healthcare system which was already struggling before Covid-19. The compounded impact of the pandemic on the collective mental health of Americans would take longer to manifest (e.g., time between trauma and presentation of a patient before a medical professional) and become measurable outcomes.

It was within this dire reality that this study was birthed-the will to uncover a path to better health for all. The current renaissance, Americans seeking alternatives to allopathic or Western medicine, started in the 1990's as more patients turned to integrative medicine (IM) and naturopathic practitioners (naturopaths) to be healed (Lee & Kemper, 2000). IM differed from allopathic medicine by applying more focus on the patient and provider relationship, using a combination of allopathic medicine methods with complementary and alternative medicine (CAM). IM used a holistic approach or "multi-modal interventions" to treat patients, including a theoretical foundation in preventative medicine to maintain wellness (Oberg et al., 2015).

Predictive and prescriptive analytics tools (PPA) were piloted in large hospital systems in the last few years to predict patient health outcomes and prescribe treatments (Oesterreich, Fitte, Behne, & Teuteberg, 2020). As of 2021, PPA tools were not developed for or marketed to primary care providers. Based on preliminary conversations with IM practitioners, they primarily used electronic medical records (EMR) and electronic health records (EHR). EMR was the standard technology to collect a digital patient chart and manage longitudinal data like medical history, diagnoses, and lab results. EHR aggregated health information shared across multiple practices, health systems, and state-based healthcare exchanges. Practitioners used their own medical training (and feedback from peers), professional experiences, and intuition to predict patient

outcomes and make medical decisions. They had limited understanding of how PPA could be applied to primary care; but practitioners were intrigued to understand how these tools might one day be applied to their profession. One practitioner held deep skepticism and did not believe emerging technology could mimic the complexity of her medical decision-making (MDM) process focused on providing whole body care to her patients.

This research took a qualitative approach to explore the potential for future convergence of IM and emerging technology to heal patients. The main research question is:

How can predictive and prescriptive analytics tools (PPA) support/innovate integrative medicine (IM) decision-making processes and improve outcomes for patient populations suffering from chronic pain?

This research sought to examine the unique dance that occurred between doctors and patients along the healing process (see Research Design Summary in Appendix A). A deeper understanding of the nuance or "essence" in the way IM practitioners made medical decisions (Van Manen, 1990) could help answer the following secondary research questions:

1) How do IM providers describe the tasks they consistently perform (e.g., the steps in evidence-based MDM)?
2) How do IM providers perceive the PPA technology currently being used in U.S. hospitals to predict patient outcomes and provide recommendations to providers?
3) How can an understanding of current IM practice be used to identify the potential usefulness of PPA and high-level future requirements?

To increase the likelihood of focused, impactful conversations with medical professionals the scope was reduced to one medical indication. This research focused on medical decisions made during the treatment of chronic pain, one of the top five most prevalent U.S. health issues

(Oberg et al., 2015). This population choice ensured there would be a large enough sample of potential research participants. Also, the complexity of treating patients presenting with chronic pain was identified as a factor that could lead to interesting insights.

A technology vendor (whose pseudonym is PPATech in this paper) supported this research, hoping to gain feedback from healthcare providers that operated outside of hospital systems. PPA developers lacked understanding of how primary care providers who practiced IM perceived their suite of software-as-a-service (SaaS) products. PPATech provided three visualizations to share with research participants, screenshots of real-world chronic pain scenarios. IM practitioners provided feedback on the user interface. Their overall perceptions of PPA (values, beliefs, and attitudes) and critique were used to identify how the technology may or may not fit into their workflow.

II LITERATURE REVIEW

The literature review included a stepwise search for peer-reviewed journals in three separate databases: Web of Science, EBSCO, and PubMed. The initial searches included the following topics to find articles on emerging technology:

- (“PPA” or “predictive analytics” OR “prescriptive analytics” OR “machine learning” OR “artificial intelligence” OR “big data” OR “AI”)

There was a large swath of results: EBSCO (15,215), Web of Science (393,084) and PubMed (92,122). Additional search topics were added systematically to identify articles that also focused on the medical field:

- (“medicine” OR “medical” OR “healthcare” OR “provider” OR “doctor”)
- (“decision making” OR “treatment” OR “intervention” OR “recommendations” OR “recommend” OR “care” OR “patient”)
- (“integrative”)

Selected abstracts were analyzed to identify the research approach, empirical basis, analysis method, and overall validity of the study results. A subset of articles provided U.S trends in holistic patient care, definitions of IM, definitions of PPA and application to healthcare.

Six articles provided confirmation that research on the convergence of IM and PPA had value. All six were recognized by Web of Science with Journal Impact Scores between 0.959 to 4.225. The six papers had a wide range of visibility, being cited between 2 and 250+ times. These publications included a mix of qualitative and quantitative research, including literature reviews, theoretical papers, AI/ML modeling and a numerical analysis of doctor intake forms. Additional details about study validity and key findings were included in Appendices B and C). The literature review confirmed IM helps complex patients who need an alternative to allopathic

medicine (Young & Kemper, 2013). These patients tend to seek IM after receiving less than satisfactory results or no relief from chronic pain after visiting their primary care provider.

The next set of findings focused on limitations in the technology. The need for further research was identified for external validation, implementation logistics, and data exchange and privacy (Angehrn et al., 2020). For AI to have full benefit, it must pull together disparate data sources in a manner that protects patient privacy. “Socio-economic, gender, and race characteristics” were important factors for refining algorithms. However, surfacing this type of data via the AI user interface could create bias amongst doctors and/or allow for misuse of PPA tools (Prosperi, Min, Bian, & Modave, 2018).

Unique applications of AI to healthcare were well described in the literature. Within a well understood patient population, the algorithms were very accurate at predicting further disease/illness (Geng et al., 2020). However, use of AI to make predictions across multiple physiological systems not well understood (Ching et al., 2018). Increased complexity of disease states made it very difficult to predict progression with accuracy or recommend a comprehensive list of potential treatment modalities and medicines. AI was often used to predict health outcomes (system-by system or for one disease state). Thus, adoption of AI was described as a gradual process and additional research would be needed to avoid incorrect application (Chin-Yee & Upshur, 2019).

IM had clear benefits (especially to patients suffering from complex conditions) and the shift to personalized healthcare was predicted to continue. So, there could be a market for technology supporting IM in the future. However, peer-reviewed articles about application of AI at the point of care, the real-world experience of introducing emerging technology, measuring effectiveness, and encouraging adoption were lacking.

The next round of search focused on the study case: treating chronic pain. Seventeen articles were identified to understand medical definitions of this condition, compounding factors, and U.S. trends. The identified papers highlighted treatment and intervention options, including many CAM modalities. Articles also described how predictive modeling of patient outcomes is being applied to this disease state.

To understand how to identify the potential fit between IM and PPA, a separate literature review was performed. The initial searches for the key phrase "Task-Technology Fit" provided the following results for academic journals: EBSCO (5,697), Web of Science (511) and PubMed (31). Filtering for "Healthcare" reduced the list to 1,541; 13; and 15, respectively. A final search adding the terms "artificial intelligence" only provided one relevant result. Thus, while research on TTF in Healthcare was rather saturated, the focus of this study (e.g., identifying fit of emerging technology) was quite novel.

The following sections describe the three literature review streams: IM decision making, Predicting and Prescriptive Analytics, and treating patients with chronic diseases.

II.1 Integrative Medicine (IM) Decision-Making

IM applied more focus on the patient and provider relationship, using a combination of allopathic medicine methods with complementary and alternative medicine (CAM). IM used a holistic approach or "multi-modal interventions" to treat patients, including a theoretical foundation in preventative medicine to maintain wellness (Oberg et al., 2015). Mechanism and vitalism sat on two separate sides of the healthcare spectrum. Mechanism focused on the mechanics of diagnosing the root cause of disease and decreasing, extracting, or eliminating the issue. In stark contrast, vitalism sought to promote overall mental, physical and spiritual

wellness, use preventive care to reduce likelihood of illness, and take advantage of the body's ability to maintain homeostasis within physiological systems.

Along this spectrum, the typical primary care doctor trained in the U.S. system practiced some form of mechanism with varying desire, understanding, and ability to choose less invasive measures to treat patients. Primary care doctors typically prescribed biomedical treatment (e.g., pharmaceutical products) to reduce symptoms and/or eliminate the disease. This familiar pattern of allopathic medicine, called "Western Medicine" because of its modern rebirth in Europe and the U.S., was often described as "traditional medicine" in the literature.

Allopathic medicine relied on an inductive process or series of questions to identify the likely cause of disease and remove it: identify and treat (Zejf, Snider, & Myers, 2019). Primary doctors, family care doctors, pediatricians or generalists treated a subset of general causes of disease. If these treatments were seen as unsuitable or did not have the intended effect, the patient would be referred to a specialist who also practiced some form of mechanism (e.g., a cardiologist to implant a stent, an oncologist to initiate radiology or chemotherapy treatments, or a specialty surgeon to perform a hip replacement). A patient with serious problems had multiple doctors treating one or more issues. However, the overall nature of the care was not holistic (e.g., not focused on whole body, mental health and spirituality).

A second body of medical care, complementary and alternative medicine (CAM), was described based on its relationship to allopathic medicine (Pang et al., 2015) (Barrett et al., 2003) (Naliboff, 2002):

- Complementary: used along with allopathic medicine
- Alternative: used instead of allopathic medicine

The seemingly endless number of different modalities or treatment options in CAM varied across articles; but often included mindfulness, yoga, chiropractic, acupuncture, and massage therapy (Naliboff, 2002). Finally, in contrast to biomedicine as the first choice, providers using CAM sought to prescribe treatments with a safer side effect profile like dietary supplements, herbal remedies, and homeopathic options where appropriate.

In the literature, CAM and Naturopathic Medicine (NM) were sometimes described interchangeably when referencing a specific modality. However, NM was more often described as a separate health practice whose practitioners focused on "the restoration of health" and viewed disease more as a set of physiological processes that had broken within a person rather than an entity to remove (Zejf et al., 2019). Practitioners upheld strong beliefs that "vitalism leads to a perspective of health and health care that is uniquely beneficial to helping patients solve their health problems" (Amy Neil MS, 2019; Coulter, Snider, & Neil, 2019).

The description of NM varied greatly by country; but was generally defined as "a system of primary health care: an art, science, philosophy, and practice of diagnosis, treatment, and prevention of illness (Wardle, Adams, Lui, & Steel, 2013)." Naturopathic modalities included therapies "to detoxify…eating clean, habit and lifestyle modification…and hydrotherapy (steam, hot tub use, colonic irrigation)" (Lee & Kemper, 2000).

In 2020, there were approximately 6,000 licensed U.S. naturopaths who achieved advanced degrees (Naturopathic, 2020); including "doctors, dentists, nurses, midwives, pharmacists and physical therapists who provide [traditional medicine]/CAM services to their patients" and practitioners who use the vast sum total, methods and healing systems from indigenous cultures (WHO, 2019) (Naliboff, 2002). Thus, the term "traditional" more accurately

described the CAM modality of African herbalists or Chinese acupuncturists developed thousands of years before the allopathic methods used in the U.S.

The literature addressed the lack of understanding and distrust found in U.S. culture towards CAM modalities. Skepticism existed due to at least the following five factors:

- Research on CAM practice and outcomes is in its infancy
- Inability to conduct double-blind clinical trials for many modalities
- Lack of U.S. state-accepted licensure for the practice of many modalities
- General lack of public knowledge due to the misrepresentation of certain practices
- Negative results and/or malpractice from charlatans claiming to practice CAM

There were misconceptions about how doctors applied CAM/NM. And most U.S. citizens were unaware naturopaths received medical training (4 years) or that many MDs added CAM disciplines to their practice (Oberg et al., 2015) (Lee & Kemper, 2000). Negative references to naturopaths as fake doctors may also be attributed to the "common co-option of the naturopathic identity by other less-trained practitioners" (Wardle et al., 2013). Additional descriptions of the types of medical practice and the wide variety of modalities was included in Appendix D.

Based on survey data from the 2000s, U.S. patients tended to seek CAM therapies after going to their primary care doctor first with a preference for complementary approaches over alternative medicine (Naliboff, 2002). Patients with chronic or life-threatening conditions were more likely to move to nonconventional modalities (Sniderman, D'Agostino Sr, & Pencina, 2015). Patients who adopted CAM found satisfaction in its holistic and empowering nature (Barrett et al., 2003), including longer visits with practitioners who took a more intuitive approach to understanding the whole needs of the patient before suggesting care and/or offering a referral to another healthcare provider.

IM developed as a solution to the growing issues in U.S. Healthcare, focused on both allopathic medicine and healing, with the patient-provider relationship at its crux (Snyderman & Weil, 2002). IM addressed patient's holistic needs, including the importance of maintaining a healthy lifestyle. And the practice required care providers "to serve as guides, role models, and mentors, as well as dispensers of therapeutic aids" (Snyderman & Weil, 2002).

This research was designed to understand the essence of how IM providers make medical decisions. Based on Horrigan et al., IM addressed "the full range of physical, emotional, mental, social, spiritual, and environmental influences that affected a person's health" (Horrigan, Lewis, Abrams, & Pechura, 2012). The following basic assumptions were identified by Horrigan et al.:

- The patient and practitioner are partners in the healing process.
- All factors that influence health, wellness, and disease are taken into consideration.
- The care addresses the whole person, including body, mind, and spirit in the context of community.
- Practitioners use all appropriate healing sciences to facilitate the body's innate healing response.
- Effective interventions that are natural and less invasive are used whenever possible.
- Because good medicine is based in good science, IM is inquiry-driven and open to new models of care.
- Alongside the concept of treatment, the broader concepts of health promotion and the prevention of illness are paramount.
- Care is individualized to best address the person's unique conditions, needs, and circumstances.

- Practitioners of IM exemplify its principles and commit themselves to self-exploration and self-development.

When considering technology used to predict patient outcomes, IM practitioners would expect the system to address the list above (Horrigan et al., 2012).

IM allowed the primary care provider to "involve the patient as an active partner in his or her care" (Sniderman et al., 2015). They used preventative care measures to maintain wellness; homeopathic, NM and biomedicine to treat disease (seeking the least harmful options first); and more invasive or mechanistic measures to treat a very sick patient. Madsen et al. illustrated the increasing level of overlap between techniques used in IM and conventional medicine: CAM modalities like acupuncture and chiropractic were being taught in U.S. medical schools and cognitive-behavioral therapy was offered and reimbursed by insurance payers as an IM modality (Madsen, Vaughan, & Koehlmoos, 2017).

Based on the World Health Organization 2019 report, the U.S. sought to expand coverage of "essential health services" in response to rising healthcare costs (WHO, 2019)." As consumer expectations for [better, more personalized] care rose," so did healthcare costs (WHO, 2019). However, only 22 U.S. states recognized the naturopathic license ("Regulated States and Regulatory Authorities," 2020) and reimbursement for CAM/NM services varied based on the patient's insurance provider, forcing many to pay for care out of pocket. U.S. insurance payer reimbursement continued to shift to an outcomes-based model reliant on proving patient outcomes through analytics (Ohnuma, Shinjo, Brookhart, & Fushimi, 2018), making it critical to understand how an ecosystem including IM care would be supported.

II.2 Predictive and Prescriptive Analytics (PPA)

Big Data analytics powered by AI changed the healthcare industry, transforming how healthcare providers made accurate decisions off of the data housed in EHR (Lodhi et al., 2015) (Lin, Chen, Brown, Li, & Yang, 2017) and identified the best personalized care options for unique patients (Rowh, 2019) (Paul Tiffin, 2018). The resultant impact included efficiency in treating patients before their condition worsens with reduced impact on the healthcare system (e.g., lower costs) (Nambiar, Bhardwaj, Sethi, & Vargheese, 2013) (Dasgupta, 2019).

Using machine computing or machine learning (ML), algorithms combed through longitudinal data (e.g., historical data found in a patient charts, images, "laboratory, pharmacy, insurance, and other administrative data") that were too large to manage with "traditional or common data management tools" (Raghupathi & Raghupathi, 2014). As decision complexity increased, neural network algorithms, which mimic the nerve signaling of the human brain, were often used to "model any relationship between an observed variable…and an outcome" (Miner et al., 2014). Predictive analytics used real-world settings and data to validate the algorithm and improve the model (Cohen, Amarasingham, Shah, Xie, & Lo, 2014). Then, patients' actual outcomes were fed back into the statistical models to make the system more accurate over time (Cognitive Computing, 2020).

Oesterreich et al. conducted a meta-analysis of 492 peer-reviewed journals with key-word hits in the realm of PPA and healthcare. They also interviewed nine experts to confirm the definition of PPA, identify use cases/application to healthcare, and identify the ideal future state (Oesterreich et al., 2020). Predictive analytics were focused on "health effects: and prescriptive analytics recommended next steps to avoid those affects and maintain…health" (Oesterreich et

al., 2020). This definition was curiously aligned to the preventive medicine and sustainable wellness goals of IM.

Oesterreich et al. referenced the continuum of technology that provides insights to healthcare providers. The Davenport and Harris article described a 2-by-2 relationship between impact on an industry and the sophistication of the analytics tool (Davenport & Harris, 2017). Figure 1 applied the spectrum to healthcare, identifying high-level questions analytics could answer for IM providers.

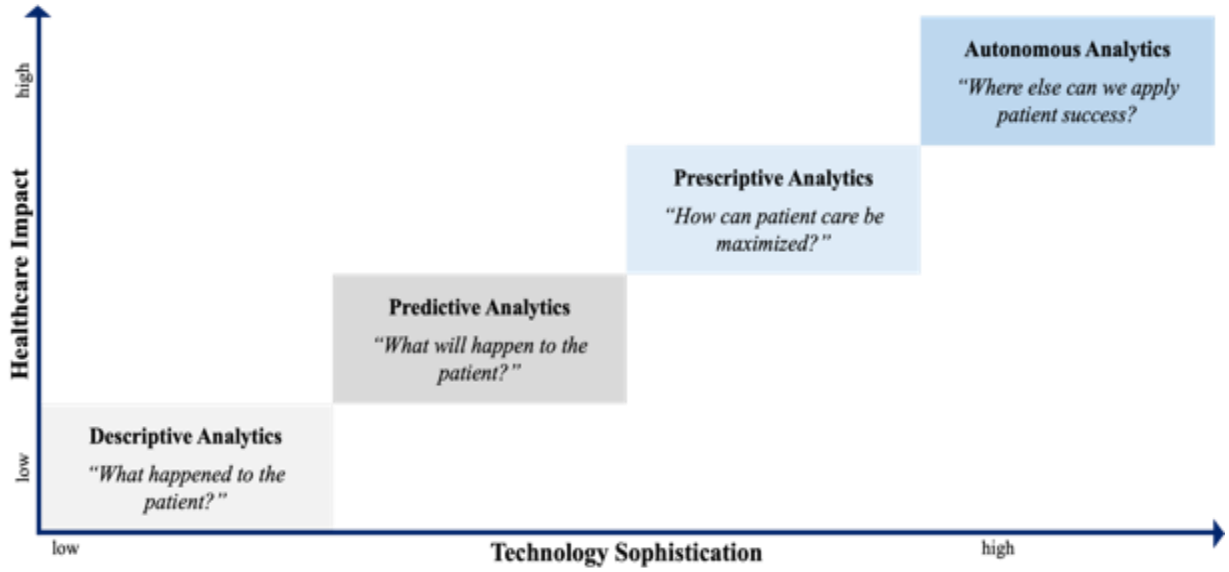


Figure 1: Diversity of Big Data and Analytics Technology Applied to Healthcare

Adapted from Figure 1 from (Oesterreich et al., 2020), the scale above described Big Data and Analytics in a model where Healthcare Impact is a function of technology sophistication. While descriptive statistics tell us what happened in the past, highly sophisticated autonomous analytics will "employ artificial intelligence to create self-learning and self-optimizing models" (Davenport & Harris, 2017) (Oesterreich et al., 2020). These autonomous

systems would mimic the minds of medical professionals, seeking to apply learnings/medical knowledge to new patient populations or disease states.

Over time the healthcare analytics market will include more vendors and niche software companies that develop platforms to manage diverse data inputs, complex conditions and diseases, mental health applications (Hahn, Nierenberg, & Whitfield-Gabrieli, 2017). The reading mentioned the development of applications outside of the hospital settings to "transform how clinical decisions are made" (Dupre et al., 2017; Peterson, 2019).

Specific to the patient's condition, PPA can predict medical complications (Stevens et al. 2001) (Peterson, 2019), likelihood of hospital readmission (Bardhan et al. 2014), expected response to treatment (Meyer et al. 2014), and patient mortality (Tabak et al. 2014). PPA tools often provide "risk scoring" which "computes the probability that certain, predetermined events in a patient's trajectory take place" (Mueller-Peltzer et al., 2020). As the algorithms are refined, this software predicted a patient's expected health outcomes with increasing levels of statistical confidence (Kansagara et al., 2011) (Rowh, 2019), automated tasks in the MDM process (Dasgupta, 2019), and lowered overall healthcare costs (Paul Tiffin, 2018).

In one study, medical practitioners identified two additional types of data that would provide valuable context to the risk score: "patient-reported symptoms (e.g., pain, limitations in function) and modifiable clinical risk factors important to predicting outcomes (e.g., BMI, smoking, emotional health)" (Franklin, Zheng, Bond, & Lavallee, 2020). These "patient-reported health status and symptoms" may not be consistently captured in EHR today (Franklin et al., 2020). Execution of care was another major variable. For example, a homeless patient may not have access to technology. Or they may be hard to locate, making follow-up steps nearly impossible to implement or monitor.

Since it is currently unrealistic to quantify and capture all "future predictors and processes that contribute to future events… estimates of risk," PPA is only as powerful (Sniderman et al., 2015) as the quality and completeness of the data used to validate the algorithm. Also, the protocols associated with patients' care are very different based on disease state (Petersen et al., 2018). For example, the treatment protocols for a Type 2 diabetes patient (Thomas, 2018) and for patients originally hospitalized with cardiovascular disease (Dupre et al., 2017) would be specific to each population. The "interpretability" needed to understand the nuanced differences in predications based on "disease trajectories" is very complex (Mueller-Peltzer et al., 2020), so algorithms which "follow a simple set of rules and logic" may make it easier to interpret the results or outputs (Miner et al., 2014). As PPA evolves along the sophistication spectrum, the analytics should predict patient outcomes "under novel circumstances" and clearly present the options for care (Chin-Yee & Upshur, 2018).

The literature provided several examples of limitations to predictive models. The most serious limitation was bias. Any bias in how the patient population was selected to develop the algorithm would expose the technology to inaccurate predictions (Chin-Yee & Upshur, 2018). Also, the exclusion of important variables as inputs (e.g., using a solely Allopathic view to select clinical health factors), would bias the prescriptive outputs toward mechanism and more invasive treatment methods. There reading described a future "opportunity to transform the consciousness embedded in artificial intelligence, since it is in fact, in part, a part of our own collective creation" (Noble, 2018).

Existing risk models typically focused on one specific event or disease state and did not predict multiple outcomes (Lin et al., 2017). Predictive models accurately explained "group risk," but struggled to estimate the personalized situation or needs of one patient (Sniderman et

al., 2015) and imperfectly explain clinical outcomes. Due to limitations in a nascent, emerging technology, the models for predicting patient readmission rates or risk prediction models (Kansagara et al., 2011) only accurately predicted for a subset of the patient population. Models that cannot replicate the complexity of the patient's unique health experience performed poorly (Kansagara et al., 2011) and were sometimes no more powerful than common practitioner sense (Damery & Combes, 2017). Thus, PPA could not currently "replace the physician in the process of care" (Sniderman et al., 2015).

It will be important to understand the treatment protocols used by IM providers. While some steps in care may be described broadly across participants, others will be unique to the practitioner's medical practice and only uncovered through deep, qualitative analysis. The fact that application of inaccurate PPA could lead patients/providers to take incorrect next steps should be considered.

II.3 Research Case: Treating Patients with Chronic Pain

Study design required choosing a medical condition that most IM providers (study participants) encountered and would be able to clearly describe. Grounding provider stories in one area or patient type would make it easier to compare experiences across the population. Also, specific patient and treatment examples would increase "experiential detail, concreteness, vividness, and lived-thoroughness" (Van Manen, 2016).

This research focused on chronic pain because this condition was highly prevalent, highly complex to diagnose, presented "an array of adverse health events" (Lin et al., 2017), and could be treated in various ways. Chronic pain was officially recognized as pain lasting at least three months in the International Classification of Disease (ICD-11) (Treede et al., 2019). This

condition either had a primary characterization (pain identified as a separate disease) or secondary characterization where chronic pain was a symptom of the "perceived root cause (e.g., cancer, surgery, etc.)" (Barke, January 17, 2019). "The three most common diagnostic categories" were back pain, psychological disorders, and joint pain, often treated with CAM modalities like acupuncture and massage therapy (Pang et al., 2015). Additional description of the chronic pain ICD code was included in Appendix E.

High-impact chronic pain (HICP) was pain experienced for more than 6 months that seriously limits quality of life (QOL) (Janevic, McLaughlin, Heapy, Thacker, & Piette, 2017), including "worsening health, more difficulty with self-care, and greater health care use" (Grol-Prokopczyk, 2017). IM practitioners were likely to use the Global Pain Scale (GPS) to subjectively measure the level of pain and inform the treatment protocol (Janevic et al., 2017). IM providers practicing vitalism focused on improving the patient's overall QOL, ability to perform day-to-day activities, capacity, and mobility versus the simple "elimination of pain" (Schneiderhan, Clauw, & Schwenk, 2017)."

The literature review uncovered the following Health statistics for chronic pain:

- 1 in 5 US adults were estimated to have chronic pain in 2016 (Kuehn, 2018)
- Pain was among the top five reasons patients seek medical attention (Oberg et al., 2015)
- Higher severity of chronic pain (and associated disability) was reported from female, less educated, and poorer patients (Grol-Prokopczyk, 2017) (Kuehn, 2018)
- More disability associated with pain was reported amongst African Americans and those in the lowest wealth quartile (Janevic et al., 2017)
- Patients sought IM for chronic pain more frequently than any other condition (Horrigan et al., 2012)

- Chronic pain costs were "estimated to exceed the costs of heart disease, cancer and diabetes," largely due to impact of chronic postsurgical pain (Katz et al., 2015)

The prevalence of HICP was impacted by multiple, often overlapping variables like race, gender, veteran status, and socio-economic factors.

Sadly, treatment of chronic pain through the use of opioids led to a public health crisis with the U.S. leading other nations in addiction rates (*Robinson Country Intelligence Index, Georgia State University*, 2020). Opioid prescriptions have more than doubled, leading to increased "rates of opioid use disorders and overdose deaths" (Bachhuber, Saloner, Cunningham, & Barry, 2014). Recently, the large drug manufacturer, the Food and Drug Administration mandated Purdue Pharma to shut down business and pay more than $8B USD in fines due to their role in the miseducation of the healthcare industry and overlooking the off-brand use and misuse of their flagship product OxyContin (Isidore, 2020). A 2017 study of 2,897 patients concluded that cannabis which has "efficacy in treating chronic pain" provided "relief on par with…other medications, but without the unwanted side effects" (Reiman, Welty, & Solomon, 2017). The literature identified alternatives to opioids or non-pharmacological means to treat chronic pain, including CAM modalities like mindfulness (Dowell, Haegerich, & Chou, 2016) (Majeed, Ali, & Sudak, 2018) that IM providers may choose.

The literature review also produced many categorical reasons why there might not be a convergence between IM and PPA for managing patients suffering from chronic pain:

- Complexity of chronic pain treatment protocols may be too high
- Nuance in the IM treatment of Chronic Pain may not lend itself to PPA
- Number of data sources identified may be too high for PPA to accommodate
- There could be overall lack of TTF (fit) when applied to the IM healthcare setting

- Algorithm aversion amongst IM practitioners may be too high

The next section addresses the theoretical framework used to explore the primary and secondary research questions.

III THEORETICAL FRAMEWORK

III.1 Alternative Conceptualization of Task-Technology Fit (TTF) Theory

TTF was a golden theory with more than 25 years of application that provided a framework for understanding PPA's future value to IM. TTF emerged in the 1990s in Information System (IS) theory as a construct to objectively assess systems based on the end user's evaluation (UE) of the technology (Goodhue, 1995). Technology investment could be justified or supported by organizations and managers when there was a "better fit between technology functionalities, task requirements, and individual abilities" (Goodhue, 1995). UE acted as a surrogate for overall TTF and was measured using survey questions and an agree-disagree, 7-point, Likert-Type scale (Goodhue, 1995).

TTF was measured across the following eight factors: quality, locatability, authorization, compatibility, ease of use (EOU)/training, production timeliness, systems reliability, and relationship with users (Goodhue & Thompson, 1995). Goodhue's original survey results showed that organizational performance (efficiently and effectively executing work/corporate goals) increased when TTF was higher. However, high utilization of a "poor system" (with low TTF) would have very negative consequences on individuals and organizations (Goodhue & Thompson, 1995).

Another pivotal paper considered fit within different units of analysis (groups and individuals). Zigurs and Buckland measured the impact of group support systems (GSS) on team performance. While results were mixed, higher fit between technology characteristics and the work at hand was proposed as "the most efficient way of dealing with the cognitive load of a given task" (Zigurs & Buckland, 1998). Also, the right technology promoting

communication/collaboration across a team of users was believed to deliver efficiencies by increasing “cohesiveness and conflict resolution” (Zigurs & Buckland, 1998).

System adoption was impacted by perceived technology EOU, the expectation that technology use will require minimal effort, and perceived usefulness (Davis, Bagozzi, & Warshawl, 1989). Usefulness was “the prospective user’s subjective probability that using a specific application system will increase his or her job performance within an organizational context” (Davis et al., 1989). As the complexity or diversity of tasks increased, perceived technology EOU reached an upper boundary for predicting TTF (Mathieson & Keil, 1998). We would expect various user types to have different levels of technology use (e.g., frequent users versus casual users) and require unique functionality to succeed in their roles (Mathieson & Keil, 1998). Thus, in a complex, Healthcare scenario, an average EOU score across individuals or groups handling different tasks would not be a good predictor for fit.

Shirani et al. used TTF to study the effectiveness of communication tools to impact “organizational-decision making,” representing an even higher unit of analysis (Shirani, Tafti, & Affisco, 1999). Applied to healthcare this version of TTF would focus on a hospital system or department instead of an individual doctor. Task characteristics included “group performance on less- and more-structured tasks” with performance measured as the number of ideas generated by the team (Shirani et al., 1999). This study also represented an evolution of the theory to consider fit across multiple task categories and technologies.

Goodhue et al. revisited limitations to the theory suggesting UE should be considered with caution because of the potential inaccuracies in self-reporting technology utilization (Goodhue, Klein, & March, 2000). Howard and Rose also discussed TTF limitations, introducing the Task-Technology Misfit (TTM) concept that “Too Little” or “Too Much” functionality could

negatively impact "[technology] adoption, performance, and business success" (Howard & Rose, 2019). These challenges to TTF suggested researchers should take deeper dives into the true needs of the people performing the work and then accurately identify technology fit.

Several studies applied TTF in a Healthcare setting (mostly hospitals), focused on the systems used during the MDM process. Chen et al. studied the concept of "leagality" to address the elimination of non-value-added tasks "lean" and the ability to quickly respond to changing conditions (under time pressure) "agility" (Chen, Yu, & Chen, 2015). TTF was used to understand how a computed tomography (CT) patient- referral mechanism served the needs of two hospital systems (via a case study) to identify the delta between the As-Is CT system and the ideal future state (Chen et al., 2015).

The literature review only uncovered a few articles about TTF applied to AI tools in healthcare. Artificial intelligence-based medical diagnosis support system (AIMDSS) like PPA have only been used in practice for a few years at the time of this study (Fan, Liu, Zhu, & Pardalos, 2018) and writings about TTF theory peaked in the early 2000's. Fan et al. surveyed 202 healthcare professionals and identified six factors other than task and technology characteristics that influence the "behavioral intention" or likelihood of adopting AI: personal innovativeness, performance expectancy, effort expectancy, propensity to trust (technology), initial trust (in the effectiveness of the technology), and social influence (to use the technology) (Fan et al., 2018).

For decades, researchers used TTF to measure current task and technology characteristics to measure fit in the current state. Fit was important in healthcare because misdiagnosis and medical error introduced and/or caused by technology use literally had life or death consequences. However, business transformation and innovation require practitioners to be

future-focused; predicting how the healthcare industry, relevant regulations, and emerging (or nonexistent) technology may be applied. Due to the exploratory nature of the research question, I used a novel theoretical framework called Future-Focused Task-Technology Fit (FFTTF).

FFTTF explored the gaps between the current and ideal future state to create an "understanding of TTF [that guides] practitioners to pair emergent technologies with appropriate tasks" (Howard & Rose, 2019). This alternative theory along with "established approaches such as design thinking" should be researched together to learn the nuances of what different user types expect from using AI-based tools (Maedche et al., 2019).

III.2 Task Characteristics: IM Decision-Making

This engaged research sought to prove or disprove if PPA could be used "as a means by which goal-oriented individuals perform tasks" (Goodhue & Thompson, 1995). While MDM was the primary focus, all five tasks categories in the table below were expected to be described by study participants (Zigurs & Buckland, 1998):

Table 1: IM Task Types (adapted from Zigurs and Buckland, 1998)

TASK TYPES	DESCRIPTION/APPLICATION TO HEALTHCARE
Simple Tasks	▪ Identifying a single desired outcome without interdependencies ▪ Filling out questionnaires with historical health data
Problem Tasks	▪ Finding a single outcome from multiple options ▪ Choosing between multiple treatment options based on a well understood diagnosis
Decision Tasks	▪ Creating a solution from multiple conflicting options ▪ Designing a dynamic treatment plan for patient suffering from multiple issues
Judgement Tasks	▪ Resolving conflict and issues ▪ Managing iterative communication with a patient who gets worse, rejects recommendations, and/or is non-compliant with treatment/ medication/interventions
Fuzzy Tasks	▪ Understanding a highly complex issue

	▪ Considering information from other providers (e.g., second opinions) to diagnose a tough patient

The following PPA use cases (UC) or were identified in the meta-analysis (Oesterreich et al., 2020):

- UC1-Planning and Coordination
- UC2-Diagnosing and predicting disease
- UC3-Decision support
- UC4-Risk assessment
- UC5- Reducing readmission [to the hospital]
- UC6-Diagnosing and predicting mental health disorders
- UC7-Health monitoring
- UC 8-Diagnosing and predicting injuries and disorders

These are task categories within which to apply the technology. Practitioners participating in this research (using the IM paradigm) would most likely be focused on diagnosing complex patients, maintenance of health, and holistic treatment (Use Cases 1, 2, 3, 4). IM practitioners may also consider the mental health implications while treating patients (Use Case 6). Surprisingly, preventative health (a goal of IM, CAM, and NM) and recommending alternative treatment modalities were not called out as a unique use cases. A phenomenological approach was used to gain a deeper understanding of the steps MDM and the task categories performed in IM.

III.3 Technology Characteristics: PPA

The study design also included a unique opportunity for IM practitioners operating inside and outside of hospital systems to provide their perspectives on PPA technology. That feedback would include perceptions about the functionality, user experience (UE) and other system needs or technology characteristics that would theoretically improve the performance of IM professionals if they were made available (e.g., future state capabilities).

There were several PPA capabilities called out in the literature that could be identified as technology needs for IM practitioners. Based on Raghupathi's perspective on Big Data analytics in healthcare, users would expect PPA to be "menu-driven, user-friendly and transparent" with limited "lag between data collection and processing" (Raghupathi & Raghupathi, 2014). It was expected that technology expectations would mirror the eight TTF factors across three categories; decision making, operational needs, and responses to the dynamic healthcare environment (Goodhue & Thompson, 1995):

Table 2: TTF Factors Healthcare (adapted from Goodhue and Thompson, 1995)

TTF FACTORS	APPLICATION TO PPA IN HEALTHCARE
Quality	▪ Access to up-to-date healthcare data and laboratory values at the right level of granularity for providers ▪ Access to accurate calculations, predictions, and recommendations based on high-quality data
Locatability	▪ Relevant patient data, associated metadata, and descriptions about the data are easy to find and comprehend ▪ Navigation to necessary data is intuitive and occurs in a timely manner
Authorization	▪ Rights and roles-based system provides access to appropriate PPA modules and functionality ▪ Providers, case workers, and others only access their subset of the data, protecting patient privacy

Compatibility	▪ Patient, laboratory, pharmacy, insurance payer, and transactional data can be shared and interpreted between multiple healthcare systems and surfaced via PPA
Ease Of Use/Training	▪ Providers have a positive overall perception of the PPA UE ▪ Initial investment is made to train end users to succeed with the technology ▪ Ongoing refresher training and user support occurs
Production Timeliness	▪ PPA is accessible for use when needed ▪ Relevant data is available along the provider's workflow
Systems Reliability	▪ PPA performs the expected functions ▪ Delivery of capabilities supports end users' needs
Relationship With Users	▪ PPA is designed with the end user(s) in mind ▪ Dynamic system supports unique needs of IM providers ▪ PPA delivers information that supports IM MDM and positive patient outcomes ▪ Feedback loop includes end user groups to influence development cycles ▪ PPA meets healthcare expectations to do no harm to patients

Because predictive and prescriptive analytics tools designed for IM practitioners did not exist at the time the research was conducted, study design did not include measurement of the eight TTF factors above to determine fit.

III.4 Impact of Algorithm Aversion on TTF

Doctors endured many years of training and testing to receive their medical license. Over time, their knowledge was honed by real-world experience with patients and ongoing learning. Even if the PPA functionality hypothetically met all of an IM practitioner's needs (e.g., TTF was high) and the technology supported the tasks performed, many providers would still reject the idea of AI as a supplement or replacement for their intuition and expertise (Dietvorst, Simmons, & Massey, 2018). This algorithm aversion (AA) could occur even after providers witnessed the system in action or understood that it is consistently more accurate than human judgement. AA could especially arise in providers treating HICP patients who may need multiple modalities

and/or may never be “cured” of their pain. They may not trust PPA to solve for this level of complexity.

Suryaningrum proposed a new IS model where performance was influenced by TTF and actual usage (similar to utilization in other models). TTF influenced three factors that drove the individual’s “behavioral intention” for “actual usage” (Suryaningrum, 2012):

- Attitude: perceived usefulness, EOU, and risk of using technology
- Subjective Norm: interpersonal and external influences that shape beliefs
- Perceived Behavioral Control: self-efficacy or confidence to perform tasks, resources to perform work, and perception that behaviors are controllable

In an ideal scenario, healthcare providers would have high behavioral intention with high TTF, reducing AA and driving up technology usage and performance (e.g., positive patient outcomes).

Using the Suryaningrum model, algorithm aversion toward PPA would only decrease under five conditions:

- TTF is high (matching the tasks of the end user or group)
- Perceived PPA usefulness and EOU are high
- Perceived risk of using PPA is low
- Subjective norms (value, attitudes, and beliefs) support use of PPA
- IM providers associate PPA use with a gain of efficacy, time, or control

PPA was not currently designed for or applied to the IM/primary care setting at the time of this study, so there was an expectation that most study participants would have limited or no understanding of the tech. Even if the PPA functionality hypothetically met the majority of an IM practitioner’s needs, it was expected that some study participants would demonstrate algorithm aversion (Dietvorst, 2016). Also, there would likely be ethical considerations that

would make providers reject recommendations from a PPA tool. We would expect them to show algorithm aversion in situations where inaccurate outputs could "severely compromise a specific patient's best interests" (Cohen et al., 2014). The tool may have high TTF, but the data we expect to be "benign, neutral, or objective" could negatively influence care decisions by surfacing information in a way that introduces bias (Noble, 2018). Or, the PPA outputs (while accurate for the test data cases) may not reflect the unique needs of certain patient populations.

AA could also occur if the system outputs were perceived to be delivered in a "black box" where providers receive recommendations without further explanation or the "inner workings are not easily scrutinized" (Miner et al., 2014). Doctors would be more apt to use an imperfect algorithm if they could perform the following steps (Dietvorst et al., 2018):

- Receive insights into how the algorithm works, interact with the mechanism
- Intervene to alter inputs of the algorithm
- Modify the outputs of PPA based on their patient insights

The next section includes the Qualitative methods used to address the research question. Several considerations were taken when carefully crafting the study design to avoid the assumption that providers will automatically adopt PPA technology.

IV RESEARCH DESIGN AND METHODOLOGY

IV.1 Phenomenological Study Design

A set of rules existed within IM around holistic patient care and the management of many treatment modalities and interventions. This code of medical practice would go unseen by someone outside of the healthcare profession. A qualitative approach was used to explore the dynamic patient-provider relationship and the lesser known "context within which decisions and actions [took] place" in this "social community" (Myers, 2019).

This research was interpretivist in nature, using the phenomenological approach described by Creswell to identify the shared human experience of IM practitioners (Creswell & Poth, 2016). No assumptions were made during study design that PPA would actually be a fit for IM practitioners. So, the methods allowed flexibility to gain a thorough understanding of the task characteristics (activities IM practitioners perform), their "lived experiences" while making decisions leading to positive patient outcomes (Creswell & Poth, 2016), and insight into the technology characteristics (providers' perceptions about PPA tools). Semi-structured interviews included "open-ended questions and dialogue" followed by several, iterative rounds of data coding, and classification (Moustakas, 1994). Deeper analysis included horizontalization to understand the collective story of all participants and uncover resultant themes (Moustakas, 1994).

IV.2 Semi-Structured Interview Script

The semi-structured interviews were split into two sections, Task and Technology. The first half of the interview included introductory questions to gain a baseline understanding of the participants' professional background, including their medical licensure, training, and years of patient experience. From there, the interview order applied the expectation that phenomenological

studies identify what occurs during the patient-physician experience followed by how the patient and doctor were impacted by the medical decision making (Moustakas, 1994). The script included open-ended questions that identified the following: (1) what providers do when treating patients (e.g., task characteristics), (2) how they treat patients holistically, (3) a deeper dive into unique steps in IM MDM.

Questions that identified the textural description or "what" included the following (Creswell & Poth, 2016):

- At a high level, please describe your methods when diagnosing a patient with chronic pain.
- At a high level, please describe how you would identify the risk level for patients.
- What are some difficulties/areas of complexity for treating/managing a patient with chronic pain?

This subset of questions was used to populate a list of high-level tasks to explore TTF. The next set of questions explored the structural description of the Task (Creswell & Poth, 2016). Questions that identified the "how" included:

- How would you describe the integrative MDM process?
- How is a holistic approach to MDM applied to a patient with chronic pain?
- Can you share an example when your intuition/expertise made you reject the standard of care or prescribe something other than the gold standard medicine for a patient?
- Please describe the tools/technology you currently use to measure/predict chronic pain patient outcomes.
- Please describe the tools/technology you currently use to get recommendations for chronic pain patients.

The final question allowed the participants to provide more details about what separates IM (vitalism and treating the holistic patient) from allopathic medicine (mechanism and managing symptoms):

- What is unique about IM that leads to successful patient outcomes?

Based on the flow of the interview, I asked this question at the beginning or end of the series of "how" questions. As needed, the interviews moved off script with additional questions used to further investigate the true differentiating factors in IM MDM.

The second portion of the interview sought provider feedback on the PPA technology characteristics and "perceived EOU" (Mathieson & Keil, 1998). Participants viewed three screenshots and were given short, spoken descriptions of the data inputs, elements of the user interface, and predictive and/or prescriptive outputs. Participants shared any previous experience with PPA and a "user evaluation of characteristics" (Goodhue, 1995) by answering the following questions:

- What is the extent of your experience with PPA tools?
- What do you like most/least about this tool (overall perception, UE, presentation of information)?
- How could these systems be modified to better serve you? What additional inputs/outputs are needed?
- What would cause you to doubt the outputs of these types of systems when treating patients holistically?
- Can you share a scenario in which your intuition/expertise would make you reject the outputs of PPA?

- Which patient types/MDM scenarios are best supported by these types of tools? Which are least suited? Why?

The final questions were future-focused, asking participants to identify if there should be convergence between PPA and IM:

- Should there be a convergence between PPA and IM? Why or why not?
- Which types of decisions could be supported by PPA? Which decisions are inappropriate for PPA?
- What is the potential for PPA tools to replace parts of your MDM process? Why or why not?
- How will technology be used to predict and measure patient outcomes and provide recommendations in 10 years?

The full list of questions across both interview sessions was included in Appendix H.

IV.3 PPA Visualization

PPATech supported this research by providing screenshots of its proprietary software-as-a-service platform (SaaS). Their PPA was integrated into hospitals' EMR to analyze patient data. This data included health records, socioeconomic factors and other variables like mobility, access to family/community support, and residential stability. The PPA platform used a repository of AI algorithms to mimic the MDM processes of medical practitioners.

The three screenshots were chosen to represent a range of analytics sophistication (Davenport & Harris, 2017). The user interface demonstrated three main capabilities:

- Prediction: a display of the patient's risk or probability of an issue occurring
- Risk Factors: the patient's clinical and socioeconomic risk factors used by the algorithms

- Prescription: display of recommendations to medical practitioners (e.g., suggested treatments, interventions, and follow up steps based on the patient profile)

The recommendations/interventions surfaced in the screenshots were based on widely adopted guidelines/protocols that were refined and approved by the hospital system that implemented the software solution. PPATech believed the ability to perform prescriptive analytics was the key factor to speed up and improve the MDM process (and a key differentiator between their platform and others on the market).

There was an assumption that a knowledge gap would exist for the research participants. Sharing visualizations during the second half of the interview made it easier to explain the following: (1) PPA tools exist and are viable; (2) PPA uses historical patient data to train the system algorithms; (3) the patient's EHR/EMR is used as input to PPA; (4) PPA provides MDM capabilities, system functionality, and a unique user experience; and (5) the outputs of PPA are patient-specific risk scores, recommendations, and interventions.

The software vendor's name was hidden to avoid potential bias. For example, a research participant may have been less apt to see the PPA tool as useful or accurate if they did not recognize the vendor name and/or it did not match the branded name of their EHR, EMR, or practice management system (technology used to schedule patient visits and manage other steps in primary care). Finally, all personally identifiable information (PII) that could be used to identify patients or providers was redacted from the screenshots.

IV.3.1 *Screenshot 1-Patient Centric View*

The Patient Portal View: Patient Centric View predicted the likelihood across a cohort of 260 patients of having negative issues within a specific time period. A series of drop-down menus

at the top of the screen allowed providers the option to filter the patient population by the following categories:

- Cancer type
- Risk level
- Location of the patient (within the hospital setting)
- Insurance Payer type/name
- Provider name
- Whether or not the patient is unmarried/living alone

Users could also enter text into an open field to search by patient name.

A list of patients was located in the bottom, left portion of the screen. All PII was hidden from participants, covered by a semi-opaque gray square. The row of information associated with a patient included his/her medical record number, date of birth, and name. The PPATech tool applied proprietary algorithms against the patient EMR data to calculate a series of risk scores. The scores were displayed across seven columns to denote the risk (medium or high) of the patient experiencing an issue within a time period:

- 6-month Deterioration
- 6-month Depression
- 30-days ER visit
- 30-Day Mortality
- 30-Day Pain
- Readmission

At the intersection of a patient row and a condition, the presence of an orange or red circle in the cell denoted medium or high risk, respectively. For example, if Patient A had a red circle in

the “30-Day Pain” column, they would be at high risk of presenting with a pain episode within 30-days of the provider viewing the information. Readmission at any time represented negative consequences for patients (and resultant cost on healthcare systems), thus did not include a time period. Clicking directly on a patient line item would allow the provider to drill down into specific risk factors and recommendations (this was not shown or demonstrated in Screenshot 1).

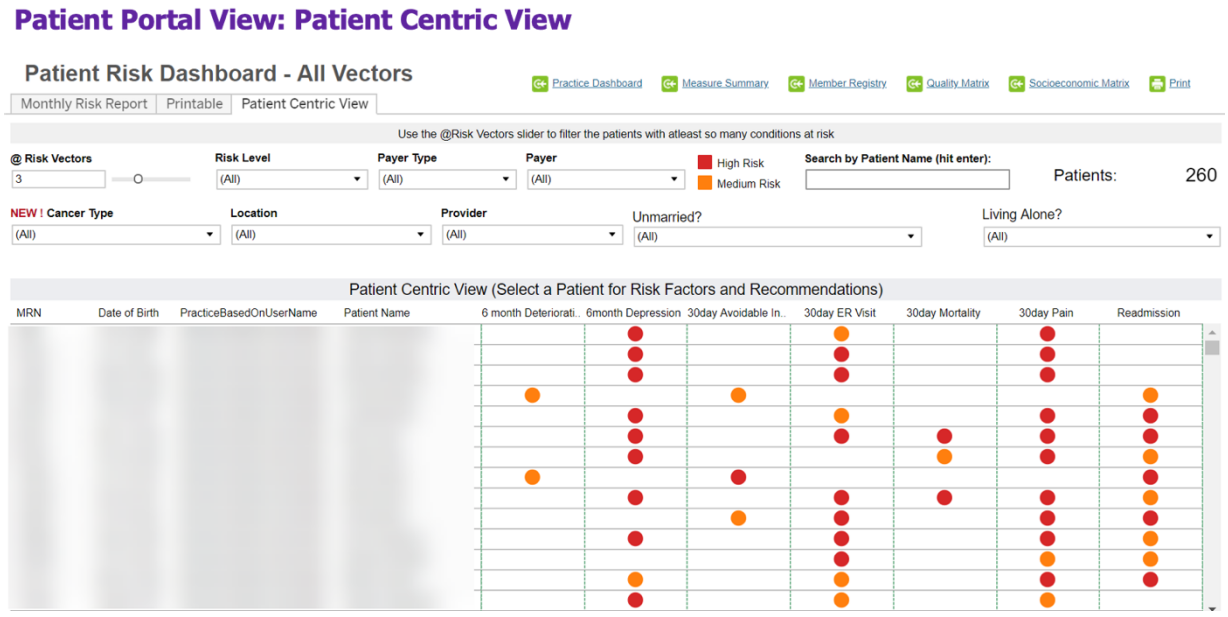


Figure 2: Screenshot 1-Predictive Analytics

IV.3.2 *Screenshot 2-High Risk #1 - 30 Day Mortality*

The Patient Portal View Example: High Risk #1 - 30 Day Mortality presented a view of a population of 750 patients ranked by their risk of mortality (death) within 30 days of the provider viewing the information. Each unique row included the patient name (redacted), medical record number, date of birth, age bracket (e.g., between 61 and 80), client identifier, date added to the list, and days on the list. The provider name was also redacted. Finally, each row also showed the following relevant information: Insurance payer name, risk percentile (e.g., Top 25), and risk level

(e.g., Medium or High). Once a patient was selected from the list, the name was highlighted dark blue, the risk level was highlighted light blue, and patient-specific information populated the bottom half of the screen.

The clinical risk factors contributing to the high-risk score were presented in a list at the bottom, left portion of the screen. The example showed some laboratory results, a diagnosis history of malignant neoplasm, diagnosis history of volume depletion and other factors. Based on the number of factors, providers could scroll bar to navigate through this list. Socioeconomic risk factors leading to a high-risk score were listed in the bottom, middle portion of the screen. The patient example had a high likelihood to lack digital and tech fluency, likely education limited to high school, lack of residential stability, low individual income, and low household income. Providers could scroll up and down through this list as well.

The prescriptive interventions were shown in the bottom, right portion of the screen. Based on the example patient's EMR data, clinical and socioeconomic factors; the PPATech algorithm created a list of recommendations for the providers to scroll through and consider. A subset of the interventions included the following actions:

- Consider reevaluating care plan
- Prepare patient's families/caregivers
- Focus on symptom management and comfort/nausea and vomiting
- Consider mobilizing community support

System functionality to undo, revert, refresh, or pause actions were not discussed during the interview. Also, the ability to share content and download information was not shared with study participants. These system features did not differentiate the PPATech user interface from

other modern SaaS platforms and their consideration would offer no additional, impactful insights about the TTF of PPA.

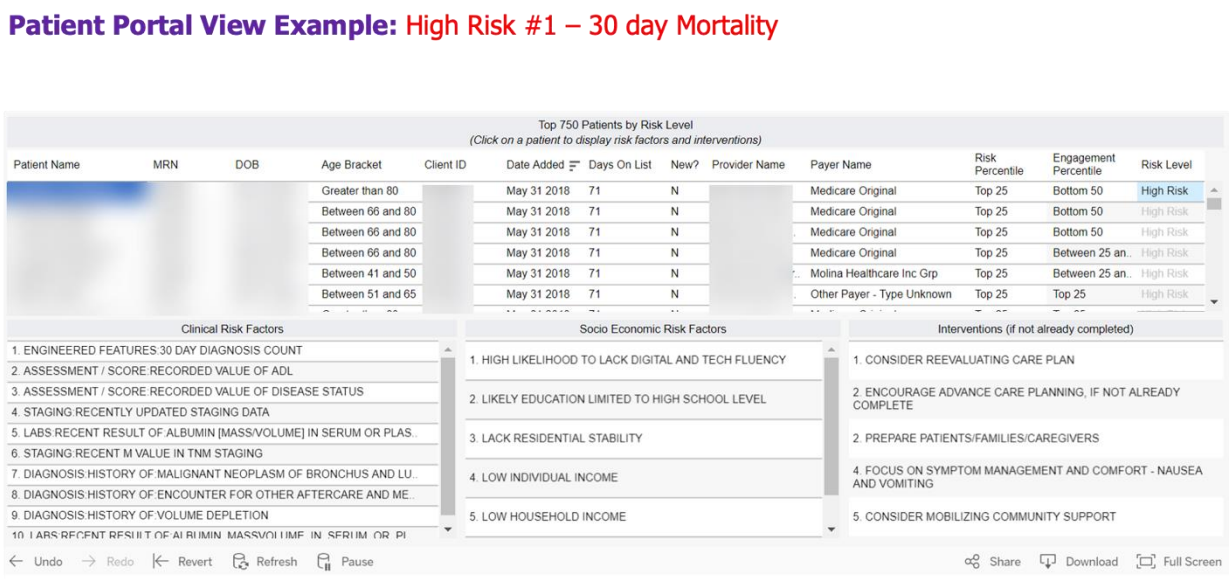


Figure 3: Screenshot 2-Prescriptive Analytics

IV.3.3 *Screenshot 3-PPA Recommendations/Interventions*

The third screenshot provided a more detailed view into the PPA functionality, showing how providers receive patient-specific recommendations. The list of patients was oriented on the left half of the screen, including the hospital room number, the patient name, and their risk level for sepsis. Selecting a patient from the population of 30 highlighted their row light purple. The top of the screen showed their name again, the medical record number, age, gender, hospital room (again), facility, unit (e.g., Nurse Unit), the date/time they were admitted, their length of stay (LOS) at the hospital, their risk level for sepsis (again), and risk percentile (e.g., Top Quartile).

In the bottom middle portion of the screen the tool listed the clinical and socioeconomic risk factors used to determine the patient's score. Clinical factors included the following:

- Current Encounter: Benzodiazepines
- Current Encounter: Cardioselective Beta-Blockers
- Current Encounter: Lab Test: Magnesium: Record of Lab Test
- Multiple Chronic Conditions

The patient's socioeconomic factors included the following:

- Lack [of] Residential Stability
- Low Likelihood of Internet Commerce
- Lower Commercial Retail Available Nearby
- Single: Likely Without Support From Spouse

The bottom right portion of the screen listed detailed recommendations and their status. The first recommendation was: "Not Started-RN-Review the Micro labs for updated sensitivities. MD-Review Micro labs for updated sensitivities and order as indicated." This naming convention designated that for this intervention there were separate steps for a Registered Nurse (RN) and Medical Doctor (MD) to complete.

The provider had the option to consider the recommendations/interventions and update the status from a drop-down menu as "Not Started," "In Progress," "Completed," or "Declined." There was also a text field where providers could enter comments to add details and/or explain their MDM. The PPATech tool collected this transactional data and the patients' future outcomes to further train the algorithm, allowing the PPA tool to improve over time and become incrementally more accurate (ML).

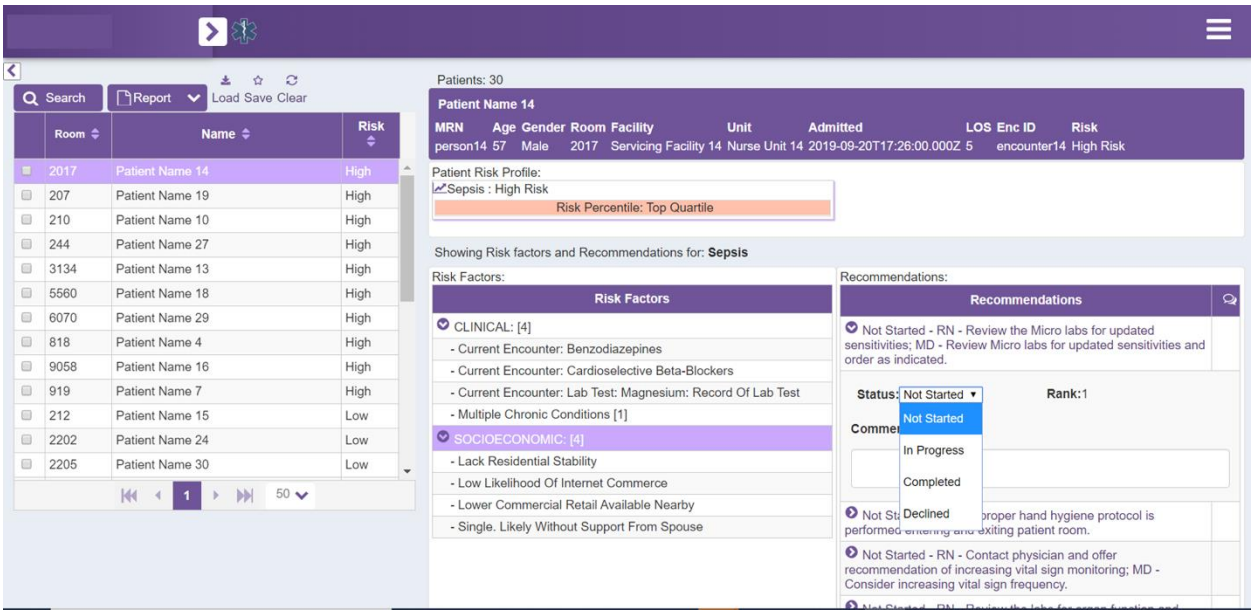


Figure 4: Screenshot 3-PPA Recommendations/Interventions

IV.4 Recruitment Strategy

After Georgia State University's institutional review board (IRB) approved the research (IRB number 21115), potential participants received a recruitment letter via e-mail (see Appendix F). Those messages included the following elements:

- The voluntary nature of the research
- The benefits of the research
- The estimated time investment for participants for 2 interviews
- The ability to opt-out of research at any time
- The need to ensure patient anonymity at all points of the process
- The compensation schedule for the research

Unanswered e-mails were followed up with additional rounds of messaging. After the first round of interviews, a snow-ball approach was used to reach out to IM professionals within study participants' professional networks.

Only active U.S. healthcare practitioners were considered for this study. The following inclusion criteria was applied when recruiting potential participants:

- Practitioners received proper medical training
- Practitioners practiced/understood the concepts of IM
- Practitioners were actively treating patients presenting with chronic pain

All research participants reviewed an informed consent form that highlighted the voluntary nature of this study (see Appendix G).

Each participant gave verbal consent before starting the interview. Research participants received $40 USD for completing the first interview session and $60 USD for the second session. They decided between compensation provided in the form of a gift card or a donation made in their name to the non-profit organization of their choice.

IV.5 Research Participant Descriptive Statistics

The criterion recruitment strategy (Creswell & Poth, 2016) was used to identify the first four participants. They described a diverse community of care providers who supported chronic pain patients. The recruitment strategy shifted to identify a cohort with a large mix of medical licensure and specialties. Recruitment was stopped after 13 participants. The final number was determined after the initial qualitative coding results reached theoretical saturation, consistent themes were repeated across participants, and no additional insights were needed to identify the "essence" of IM.

Recruitment efforts yielded 13 study participants from 11 U.S. states. 62% of study participants were women. Their medical licensure included Naturopathic Doctor (ND), Doctor of Chiropractic (DC), Medical Doctor (MD), Physician Assistant (PA), and Doctor of Nursing Practice (DNP). The shortest professional experience working with patients was two years. The longest was 31 years as a practitioner. The median experience across all participants was 9 years.

Table 3: Study Participants' Medical Licensure and Experience

Participant # / Code		Gender	State of Practice	Medical Licensure	Experience (years)
1	**ND1**	Female	MI	ND	5
2	**DC1**	Male	GA	DC	8
3	**ND2**	Male	IL	ND	2
4	**MD1**	Female	OH	MD	23
5	**DC2**	Male	PA	DC	2
6	**MD2**	Female	MI	MD	9
7	**MD3**	Female	MD	MD	18
8	**PA1**	Female	NC	PA	12
9	**DNP1**	Female	MI	DNP	12
10	**MD4**	Male	FL	MD	3
11	**PA2**	Male	OR	PA	31
12	**MD5**	Female	KS	MD	9
13	**MD6**	Female	WI	MD	13

Participants practiced in diverse medical settings: inpatient hospitals, outpatient primary care or family medicine facilities, and specialty practices like Sports Medicine or Chiropractic offices (see Figure 4 below). Three providers (PA2, and MD1, and MD6) attended the Andrew Weil Center for Integrative Medicine at different points in their careers to gain IM training above and beyond their initial medical degrees ("Andrew Weil Center for Integrative Medicine," 2021). MD2 and NDP1 practiced medicine and also worked in academia, teaching the next generation of practitioners as a Professor of Internal Medicine and Pediatrics and Professor of Nursing, respectively.

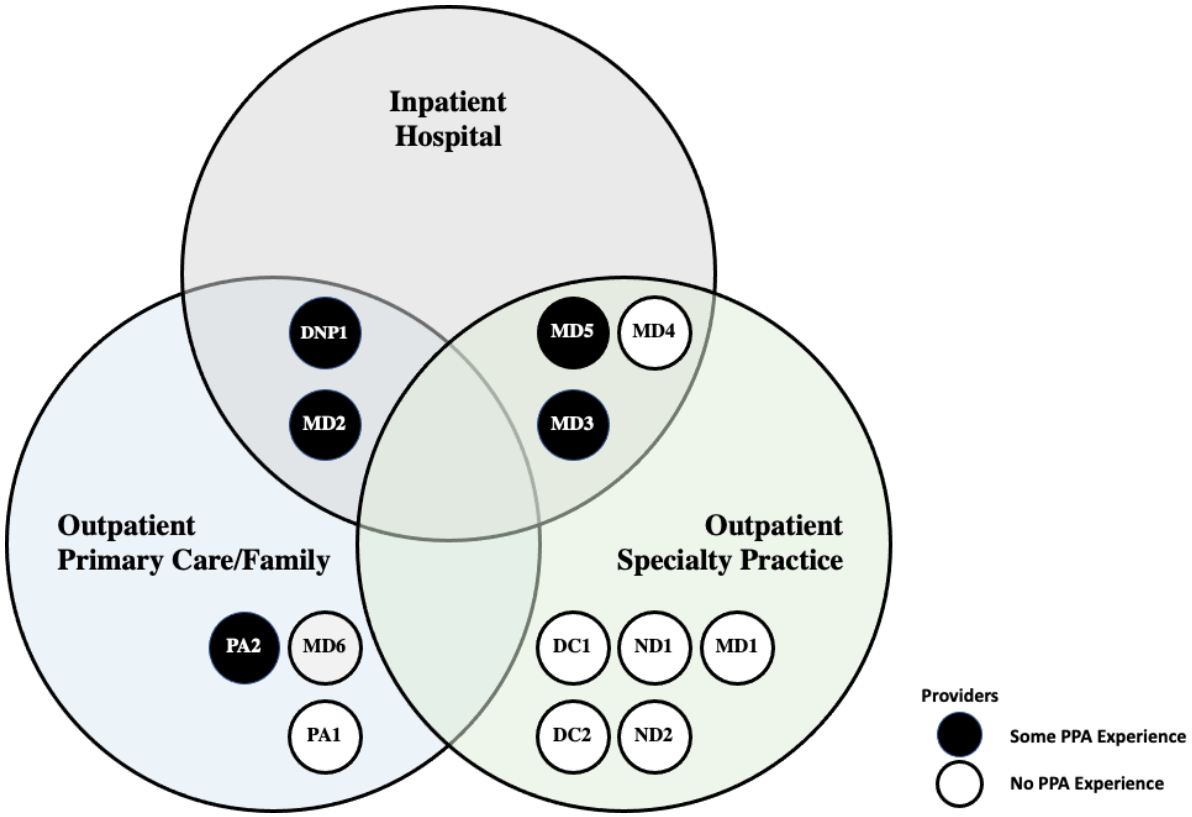


Figure 5: Study Participants' Care Setting and PPA Experience

Eleven providers had medical licensure recognized by their state of practice. While medically trained and actively managing patients, ND1 and ND2 operated in Michigan and Illinois, respectively, states that did not recognize their ND license at the time of the study. ND1 practiced under the medical supervision of an osteopathic doctor which allowed her to write prescriptions or "order higher force inventions." ND2 confirmed that patients seeking alternatives to allopathic medicine searched for an MD with "additional training in holistic medicine" or ended up paying for IM services out of pocket. And while MD1's medical license was accepted in the state of Ohio, she did not accept any form of medical insurance. She offered a diverse menu of IM services and made concessions to help reduce the overall cost to her patients.

Five providers had previous experience with PPA technology. DNP1, MD2, MD3, and MD5 operated in hospital settings where the EMR system had some form of predictive or prescriptive analytics add-on functionality. DNP1 described the tool used to predict and track hospital readmission:

"In the hospital, we keep track of congestive heart failure patients…if they keep getting readmitted within 30 days, that's a danger for us. That means that we haven't been doing our job correctly. We look at…how soon did they get to their primary care provider after we discharged them from the hospital? I've used something like this before, not specifically related to pain though."

MD2 said she hadn't used PPA but described the Michigan Automated Prescription System. This recommendation tool was "linked to EMR" and provided PPA functionality:

"I can just hit a button and I can get the latest report to see medications that we're going to prescribe to my patient. It comes with the prediction scores. If [a score] is extremely high, it'll give me a warning. So, I guess I do use some technology to assess my patients' risk. We get a quarterly

report from the state of Michigan that will compare our prescribing practices to other physicians in the same discipline of medicine…whether we're prescribing more, average, or lower rates than others in our locality."

PA2 did not have direct experience with PPA but received predictive information (risk of readmission scores) from providers at the local hospital to help him care for his patients upon release.

This group treated chronic pain patients using multiple medical specialties and various complementary and alternative modalities shown below:

Table 4: Medical Specialties and CAM Modalities Practiced

MEDICAL SPECIALTIES PRACTICED	CAM MODALITIES PRACTICED
▪ Burn ▪ Chiropractic ▪ Colorectal ▪ Controlled Substance ▪ Family Medicine ▪ Fertility ▪ Geriatrics ▪ Integrative Medicine ▪ Internal Medicine ▪ Musculoskeletal ▪ Naturopathic Medicine ▪ Obesity Management ▪ Osteopathic Medicine ▪ Pediatrics ▪ Psychiatry ▪ Psychology ▪ Reproductive Health ▪ Sports Medicine ▪ Surgery	▪ Acupuncture ▪ Botanicals/Herbalism ▪ Diet Management ▪ Hydration Management ▪ Infrared Therapy ▪ Intermittent Fasting ▪ Laugh Therapy ▪ Lifestyle Management ▪ Medical Hypnosis ▪ Meditation ▪ Mindfulness ▪ Nutrition/Supplements ▪ Sleep Management ▪ Spirituality ▪ Topical-Needle Treatment ▪ Touch Therapy ▪ Yoga

MD2 and MD3 were recruited to provide perspective from the fringe of the IM community once a patient's condition was so advanced that they required highly invasive interventions. Both participants operated in hospital systems and performed some level of controlled substance management. MD3 also performed surgery and managed patients in a specialty practice.

IV.6 Virtual Interviews and Data Integrity

There was a social-distancing restriction in place to reduce the spread of infection due to Covid-19. Research participants attended WebEx virtual meetings for both interview sessions. This allowed practitioners outside of the state of Georgia to participate with no added cost or inconvenience. The interviewer worked from a secure office and each healthcare provider took the calls from private locations to ensure no patient data was exposed during the process. WebEx provided the ability to see the participants, react to non-verbal cues, and discern when follow-up questions or additional descriptions of the PPA screenshots were needed.

The WebEx platform allowed recording of the audio and visual data in one consolidated file. Key statements, patient stories and perceptions of PPA were captured by the interviewer in real time as written notes on a printed copy of the interview script. A back-up .mp3 audio file was created using a digital voice recorder placed near the researcher's laptop. The TranscribeMe third-party service provided verbatim transcription of the participants' audio recordings as a .txt file. All audio, visual, and text files were maintained in a secure collaboration space with access limited to the researcher and principal investigator (Doctoral Advisor).

ND1 conducted her interviews on two different days. DC 1 conducted the first session, took a 15-minute break, and then finished the second session. Due to the difficulty recruiting busy professionals, the approach was changed to conduct both sessions as one interview with a duration

from 1-2 hours. The shortest duration for both sessions was 50:15. The longest duration was 1:35:44. The average duration across all 13 interviews was 1:13:12. This represented 952 minutes of qualitative data to transcribe, code, and analyze.

IV.7 Data Coding and Classification Methods

NVivo 12 computer assisted qualitative data analysis software (CAQDAS) was used to perform qualitative coding on the transcriptions (Saldaña & Omasta, 2016). Due to the futuristic nature of this study, no assumptions were made of how IM practitioners would describe what was unique about their method of practice nor how they would react to PPA. Therefore, no researcher-generated codes were created before data collection. This content was coded in an iterative fashion (see Table 5 below) that allowed for unexpected learning to occur with themes emerging organically over time (Saldana, 2011). Once patterns emerged, recoding in NVivo was used to create more "straightforward, descriptive label[s]" (Miles & Huberman, 1994).

Table 5: Iterative Qualitative Data Analysis

ANALYISIS	PROCESS	EXAMPLE
First Cycle Coding	**Get accustomed to the IM world, jargon, high-level story**	
Open Coding	Honor the provider's voice, learn IM experience/jargon Code line-by-line with short phrase	"Naturopaths use a health model not a disease model"
Holistic Coding	Exploratory-Apply one code to a sentence up to a paragraph	Long medical anecdote coded as "Patient Story"
Jotting and Memoing	Take written notes on each interview, initial perceptions Identify my original biases Identify any newly uncovered biases Write small narratives as themes arise	"Provider was introverted and straight to the point. Over the course of the interview her responses…"
Recoding	**Deeper dive into phenomenological approach**	

Descriptive & Simultaneous Coding	Code text across all interviews into 6 coding categories. Text can exist across multiple categories. Example could also be coded to Task Characteristics, Future State, Hot Quotes, etc.	Hot Quote: “And so this whole idea of treating a diagnosis or a symptom as opposed to the person, is what we're trying to get away from with integrative medicine.”
Subcoding	Used when original scheme is too broad	“Screenshot 1” updated to “Screenshot 1: Positive, or Negative, or Neutral”
Process Coding	Identify the steps performed in IM MDM process	“Assessing Patient's Spirituality With Non-Threatening Questions”
Values Coding	Identify provider’s values, beliefs, attitudes	B: “Convergence is inevitable”
Second Cycle Coding	**Finalizing Story for Results, Discussion, Conclusion**	
Pattern Coding	Identify Themes, explanations, relationships Identify TTF constructs	Draw out essence of IM Address the RQ

The first cycle included open coding, holistic coding, jotting and memoing. Open coding allowed the opportunity to understand the medical terminology/jargon used in IM. Each line of transcribed data deemed to have value received a separate code using the provider’s verbatim language. DC1 asked a patient, "Why don't you go see a primary care physician to get some bloodwork done because I think you might have such and such going on?" This was coded as “Refer to primary care for bloodwork.” No additional grouping with other codes or attempt to induce a theme occurred.

Providers painted detailed pictures of how they treated complex patients using anonymized stories. For example, the following longer anecdote from NP1 was coded holistically as “Patient Story:”

“I had a patient. She…was diagnosed [with] rheumatoid arthritis by another doctor. She came to me. She was very young, maybe 24. She presented with pretty severe rheumatoid arthritis

in her hands and her knees, and her feet. But then also was having a lot of gastrointestinal concerns as well. And so that same doctor/ that had diagnosed her put her on…some sort of a diet that was supposed to heal her gut, and it wasn't working. So anyway, we definitely addressed the diet…and put her on a more plant-based anti-inflammatory diet, but still reduced carb intake because she had some other stuff going on. Then we worked on pain relief specifically. So, I put her on supplements…to help reduce pain…things like turmeric. It was a combo supplement if I remember correctly. And so anyway, she left. She came back a month later. No change in her pain whatsoever. So, I kind of had to go back to the drawing board."

After holistic coding, recoding was performed to break large paragraphs into smaller chunks. A portion was recoded to "Patient Presented with Multiple Issues." Then the text describing the separate steps conducted by NP1 received codes: "Manage Diet," "Prescribe Supplements," and "Reconsider Treatment." This growing list of codes was compared to the original jotting, notes taken on paper during the interviews, to ensure the participant's complete story was captured.

Memoing in the NVivo tool allowed initial perceptions about the provider's style and background to be captured while still fresh. Additional memos included key statements made by participants and feedback used to improve the flow of the interview sessions. NP2 had less experience than others but provided a very thorough explanation of his process/tasks. His memos gave a roadmap for additional consideration during coding:

- NP2 performs many tasks; he practices psychology as well (mental component of health)
- The patients' QOL measures are important: this is called center of gravity, what they care about (e.g., holding or playing with their grandkids)
- IM uses a multi-organ approach which is the opposite of the way PPA was created

- There is a juxtaposition in how he practices and PPA's design (using a health model versus the disease model)
- The trend of patients choosing IM will create an uphill battle for PPA adoption

Memos captured after the NP2 interview prompted an update to the interview script format, adding three separate line items for the PPA question 2: "What do you like most/least about this tool (overall perception, UE, presentation of information)?" Stopping to ask the same question again for each screenshot created natural pauses in the script and made it easier to jot notes for the positive, neutral, and negative perceptions in the separate sections for each technology visualization. It also made it more obvious when the discussion around either of the three screenshots was truly exhausted. Finally, original researcher biases and any newly uncovered ones were recorded as memos. These biases (many created from professional experiences with healthcare providers) were noted in the Discussion section because they provided the mental and emotional framework within which I experienced or learned about the IM phenomenon (Creswell & Poth, 2016).

V ANALYSIS AND RESULTS

Analysis of the 13 interviews created a wealth of qualitative data: descriptions of integrative medical practice, perceptions of the PPA screenshots, thoughts on the future convergence of IM and PPA, and real-world experiences with patients suffering from chronic pain (and other conditions). Participants described the many steps they took to improve patient outcomes in the first half of the interview. A high-level task list was captured as written notes on the printed interview script. During the second half of the interview, each task was read back individually, and participants were asked how the system could be modified to support their ways of working. For example, DNP1 explained the importance of referrals:

"I usually have my people with chronic pain referred to a pain specialist because in those visits the pain specialist has time to locate different modalities of pain control, not just medication…I will still end up referring them…because the pain specialist usually is the one that will order those scans and then be able to move on those results…if there's a neurological problem or issue."

"Refer to a pain specialist" was captured as the note. In the second half of the interview, DNP1 was asked:

"How could the systems be modified to help you manage referrals to the multiple specialists that you might refer someone to?"

She described how PPA could support this task:

"And I'm not the expert on the resources in the community, that's what my social worker does. But I may be able to say, "Refer to social worker", and it goes directly to her notifications. And she can make the phone calls or follow up with whatever the psychosocial needs are. So, this

can be a system where…this can be flagged to them...You flagged it to the specialist that's able to follow up…if you're not able to…on your visit."

Her answer moved past the original explanation of referral to a pain specialist, mentioning the importance of connecting social workers as well. She imagined how future state PPATech workflow could "flag" or send alerts to other members of the care community. Similar questions were asked in a stepwise fashion until all high-level tasks identified in the first half of the interview were discussed.

In some situations, multiple tasks were combined into one high-level task. MD6 showed concern about "the many social-economical barriers that may prevent certain patients from getting the help that they need in order to appropriately treat their pain." Her examples, including lack of financial means, insurance issues, and lack of access to healthy foods, were aggregated to the following simplified question: "You identified barriers to access to care. How could these PPA tools support that part of your process?" This approach of reading back the identified tasks increased continuity across the two interview sessions and helped participants identify fit within the context of real processes/workflows they performed.

The final code set included the following categories: Provider Background, Patient Stories, Impactful Quotes, Task Characteristics, Technology Characteristics, and TTF (Ideal Future State). This coding schema also included several subcodes (see Appendix I).

V.1 Task: IM MDM

During the first half of the interview practitioners articulated 102 high-level tasks that were documented as written notes (see Table J1 in Appendix). During deeper analysis of the transcripts, 309 unique IM tasks were coded across all participants (see Table J2 in Appendix). They were

split into textural and structural task types. The data was then distilled to create a mutually exclusive and comprehensively exhaustive list grouped by task category as shown in Table 6.

Table 6: Textural and Structural Description of IM Phenomenon

TEXTURAL DESCRIPTION: WHAT PROVIDERS DO	
Perform Intake/ Assessment	▪ Assess patient, Record psychosocial functions, Track parasympathetic factors ▪ Take patient medical history, family history, prescription & controlled substance history, previous surgeries ▪ Record results of 1 to 3-hour assessment, clinical evaluation and physical exam, SOAP Notes (Subjective, Objective, Assessment, Plan) ▪ Perform physical exam, Collect vital signs and biometrics ▪ Perform mental health screening questionnaires, Conduct safety assessments to identify red flags ▪ Perform acute crisis stabilization (disposition planning) ▪ Perform physiological, neurological, & chiropractic assessment ▪ Request and view previous records ▪ Conduct Functional Screening, Conduct Orthopedic Tests ▪ Order a food panel and analyze results ▪ Order advanced imaging/x-rays/ultrasound and analyze results
Make/ Update Diagnosis	▪ Review Test Results, Analyze comorbidities ▪ Follow risk models based on specialist protocols

	▪ Record diagnosis ▪ Reassess original diagnosis (including from another provider)
Create/Manage Treatment Plan	▪ Interview patient to align on a care plan and/or pain contract and/or psychiatric medication treatment plan ▪ Track diet and gut rest (intermittent fasting), manage water intake ▪ Track complexity using provider-specific spreadsheets, Record matrix of CAM modalities and outcomes over time ▪ Record notes about impact of antipsychotic meds, track concomitant medication data and physical symptoms ▪ Follow state guidelines for controlled substance management ▪ Order additional genetic testing, laboratory tests, bloodwork and analyze results, monitor metabolic deficiency ▪ Track compliance to care plans, morphine dose equivalence, and changes to plans over time
Engage Care Community / Manage Administration	▪ Manage referrals and flag bad providers ▪ Manage disability application paperwork and process ▪ Interact with state Medicare system for opioid misuse
Manage Ongoing Education	▪ Communicate CAM options with patients ▪ Educate patients about holistic medicine, Share homework/research topics

	▪ Receive education on additional modalities, articles, guidelines, perform independent research on IM websites, attend conferences
STRUCTURAL DESCRIPTION: HOW PROVIDERS DO IT	
Holistically	▪ Treat Holistically (Mind, Body, Spirit), Support multi-organ approach ▪ Use talk therapy to track patient to resolution ▪ Monitor daily habits, sleep, behaviors and lifestyle modifications
Gradually	▪ Take a gradual approach, Track stepwise recommendations, patient story and results
Using Objective & Subjective Data	▪ Identify "center of gravity" (objective and subjective goals) ▪ Record subjective measures, PRO like pain scale
Within Care Community	▪ Manage ecosystem of providers, specialists, naturopaths, mental health, pain specialists, case managers, social workers ▪ Communicate about patient progress and collaborate on dynamic care plan
While Empowering Patients	▪ Provide immediate feedback to patients ▪ Help patients associate changes to QOL using gamification ▪ Track patient trust level

The first textural task in the IM process was to ***perform intake***. The intake process was consistently described as a lengthy interview in which the provider collected patient history, family

history, and an understanding of the patient's expectations for reducing or eliminating chronic pain. This initial consultation ranged from 30 minutes to 3 hours and was more exhaustive than the standard 15-minute appointments of the allopathic medicine experience. ND1 also described the "need to kind of press [patients] on some of those bits of information" to ensure the initial assessment was as complete as possible.

Based on the provider's specialty, multiple types of assessments were performed, including physical exams, functional screening, orthopedic tests, and food panels. Many providers (e.g., Chiropractors, Sports Medicine, etc.) conducted hands-on assessments of the patients' range of motion. DC2 boasted, "the only tools we use are right here, our hands. We see how you move."

PA1 and MD4 performed mental health screening questionnaires and conducted safety assessments to identify red flags that may lead to serious issues like suicide or doing physical harm to others. In some cases, they performed acute crisis stabilization for patients presenting at the hospital under duress (e.g., next steps for a bipolar patient presenting in a manic state). Disposition planning determined if the patient could be released under their own recognizance or if they needed to be committed to a mental health facility.

All providers ordered x-rays, ultrasounds, and/or another type of advanced imaging to confirm their original assessment or continue root cause analysis. Providers used a systematic process to analyze the imaging data along with the output of the intake process, other test results, medical training, and their own expertise/intuition to ***make/update diagnosis.*** In some cases they reassessed the initial diagnosis received from the patient's previous care provider. ND1 explained this collaboration process and the need to communicate with other doctors with a level of humility (e.g., not assuming a superior stance):

"I'm never going to step on another doctor's toes because we are using an integrative approach even if I don't think it is the right [diagnosis]. Like I said, it's better to rule things out than to just ignore their perspective."

Collaboration amongst primary care and specialists was necessary due to the complexity of treating the HICP and chronic pain population and the multitude of factors contributing to the underlying diagnoses.

The diagnosis and understanding of patient expectations was used to ***create/manage a treatment plan*** which included multiple components:

- A pain contract and/or psychiatric medication treatment plan
- Prescription of pharmaceuticals, medical devices, supplements, botanicals, and other options
- Expectations and documented plans for diet, fasting, and hydration
- A plan for improving lifestyle, sleep, and other contributing behaviors

The dynamic treatment plans were expected to change over time with input from the provider, patient, and extended care community. ND1 described the need to identify objective and subjective factors (including personal goals) to inform the treatment plan:

"We always try to find the center of gravity. So, let's say I'm dealing with a patient who's been having some kind of toxic exposure and that usually creates a plethora of issues later on metabolically while they may have immediate concerns that are more troubling to them. So, it might be something as simple as, 'I want to be able to hold my grandchildren again, and now I have this pain in my arms and I can't do it.' That's critically important to them. I take a whiteboard…and I will map out everything that is going on with them, what systems I think are the most affected…which ones I think are most problematic, which ones can kind of intertwine and be addressed at the same time."

Providers documented plans and the patient outcomes over time in EMR systems, on paper, or with spreadsheets that captured a unique set of health determinants. MD1 created a proprietary tracker that allowed her to "follow their subjective pain levels every three months to see how much and how quickly they get better."

Providers ***engaged a care community*** to manage chronic pain patients. The referral process was not always straightforward as there were blind spots in which providers could deliver CAM options. Also, participants needed to flag "bad providers" that had unsavory reputations. MD 3 called out her discomfort working with chiropractors: "I'm not a huge fan of chiropractors because of a couple of bad experiences that patients have had, especially when it deals with the neck." Some providers described discomfort referring patients to naturopaths, potentially due to lack of understanding of how they practice medicine. While all IM providers demonstrated a willingness to work within the community of care, some demonstrated unease with the limited nature of the care provided in the allopathic setting. DC2 further expanded the view of the care community to include the patient's family/support system.

Additional ***administration*** was necessary to manage the overall care process, ensure compliance with the patient contract, and track prescription of controlled substances in accordance with state regulations. MD2 described the regulatory process:

"The Michigan Automated Prescribing System…will show all controlled substances that have been prescribed by any physician in the state. If the patient's story aligns with what I see in the MAPS system, then it makes it a lot easier for my barriers to come down to actually believe exactly what they're telling me."

Based on degradation of a patient's QOL, providers also managed the disability application paperwork for their state government and the iterative process to receive and maintain benefits (e.g., secure reimbursement and vouchers to reduce the cost for medical service).

The final textural task category was to ***manage ongoing education***. Providers introduced new modalities to patients in an iterative fashion, educating them on the link between action taken and positive outcomes. Topics like holistic medicine, spiritual components of health, and the value of CAM options required providers to create "homework" so patients and their families could learn at their own pace. Providers also conducted their own self-study, proactively researching treatment and medication options via IM websites, medical journals, published industry-accepted guidelines, and at conferences.

Analysis of the structural task categories (e.g., how providers make decisions to improve patient outcomes) uncovered five major themes. IM requires practitioners to:

- Treat ***holistically*** (the mind, body, and spirit), supporting a multi-organ approach;
- Suggesting changes ***gradually***, tracking recommendations over time;
- ***Using objective and subjective data*** with understanding of the patient's goals;
- Communicating patient progress ***within the care community***, collaborating on the dynamic care plan;
- ***While empowering patients*** to learn about health, gaining trust in their provider.

The structural task list exposed anecdotal differences (and additional modalities) that make IM unique from allopathic medicine. Study participants identified 57 IM and Allopathic Medicine Comparisons (see Table J3 in Appendix).

DNP1 used an interdisciplinary approach to practice holistic medicine:

“So, somebody's telling me they have chronic pain. Then I'm getting the pain specialist on board. I'm asking questions about mental health to just make sure that there's no underlying depression or something else that's masking something else. I'm giving them physical therapy, not just throwing a pill at the situation.”

She used the underlying patient needs to build a unique care community. DNP1 also explained the reality that patients often need additional mental health care and comforting after receiving unexpected or bad news: “they're in my office crying, snot and tears because of this diagnosis and they can't really wrap their mind around it.”

DNP1 And MD5 both mentioned the iterative nature of educating patients about realistic outcomes and treatment options. DNP1 candidly told patients “if you are looking for no pain, that's may not be a realistic expectation for you. So now we [have] to talk about what's a tolerable pain level.” MD5 described many examples of dietary changes having a better effect than medications prescribed through a purely allopathic approach. She used a series of questions to challenge her patients and educate them on the benefits of “intermittent fasting” and “gut rest.”

Building a trust-based relationship was described as a prerequisite to better communications with patients; which is key for empowering people to learn on their own and make better health decisions. MD3 explained how her mannerisms eased tension and help establish better relationships:

“I never wore a white coat. I wore scrubs and a shirt…I don't use big words. And it's sort of like just going to your friend's house to talk about your problem. And so that was my approach to things. I'm silly…my whole goal is to make things comfortable. You have to have just a lighter touch…when you treat patients…because they have to trust you.”

PA1 boldly claimed "integrative medicine…should be the way of the world. What we've been doing in our healthcare system up till now has not worked." PA2 provided a powerful clarification that while different from allopathic medicine in practice, IM is still evidence-based at its core: "IM does not blindly accept CAM therapies just because they are complementary and alternative. They have to be strongly supported by science and evidence." This was confirmed by ND2 who joked, "what's the naturopathic treatment for appendicitis? Surgery…it's the same standard of care that we [IM providers] apply to ourselves."

V.1.1 *Phenomenological Storyboard*

After describing their tasks, participants were challenged to describe the IM phenomenon more deeply: "If you had to choose one element or the essence in how you practice, what is that one thing that leads to successful patient outcomes?" Horizontalization across their responses was captured in a table of 13 IM essence statements:

Table 7: Horizontalization of IM Essence Statements

PARTICIPANT	HORIZONTALIZATION OF IM ESSENCE STATEMENTS
ND 1	▪ Individual patient's perspective needs to be carefully considered
DC 1	▪ Grander vision of health respects the "innate intelligence of the body" to heal itself once interferences are removed
ND 2	▪ Don't view the patient as broken or view the disease; see them as a person (humanity)
MD 1	▪ Individuality requires goal of healing the whole person, so they no longer need the doctor

DC 2	▪ Dive into the root cause analysis (beyond the symptoms)
MD 2	▪ The Patient is in control (central theme)
MD 3	▪ "The human element" is the provider presenting themselves as a human, relatable with fragility
PA 1	▪ A provider must be passionate to identify the "day in the life" of a patient in order to provide individualized care
DNP 1	▪ Act as the conductor to direct patients to the specialist/modality they need
MD 4	▪ Active listening to build strength of the therapeutic alliance, understand patient's perspective
PA 2	▪ Overcome the challenges of appointment time to build patient's trust in the full menu (conventional and CAM options)
MD 5	▪ Empower the patient by consistently asking for their feedback on the care plan
MD 6	▪ Invest Time! Avoid the assembly line reality of allopathic medicine

The tasks were added to a phenomenological storyboard, a visualization that allows researchers to arrange ideas/tasks/themes in a logical and temporal order. Medical care occurred in an iterative fashion with many levels of overlap (e.g., a patient may receive a new diagnosis after referral to a specialist, causing the need to update the dynamic care plan). However, for the purpose of phenomenological storyboarding high-level task categories were used as temporal anchors. "Intake/Assessment" occurred at the beginning; "Diagnosis, Treatment Plan, Care Community" represented the iterative, middle step; and "path to wellness" was the end goal. Then,

the phenomenon was split across these three stages, establishing an easy-to-consume chronology shown below (Creswell & Poth, 2016).

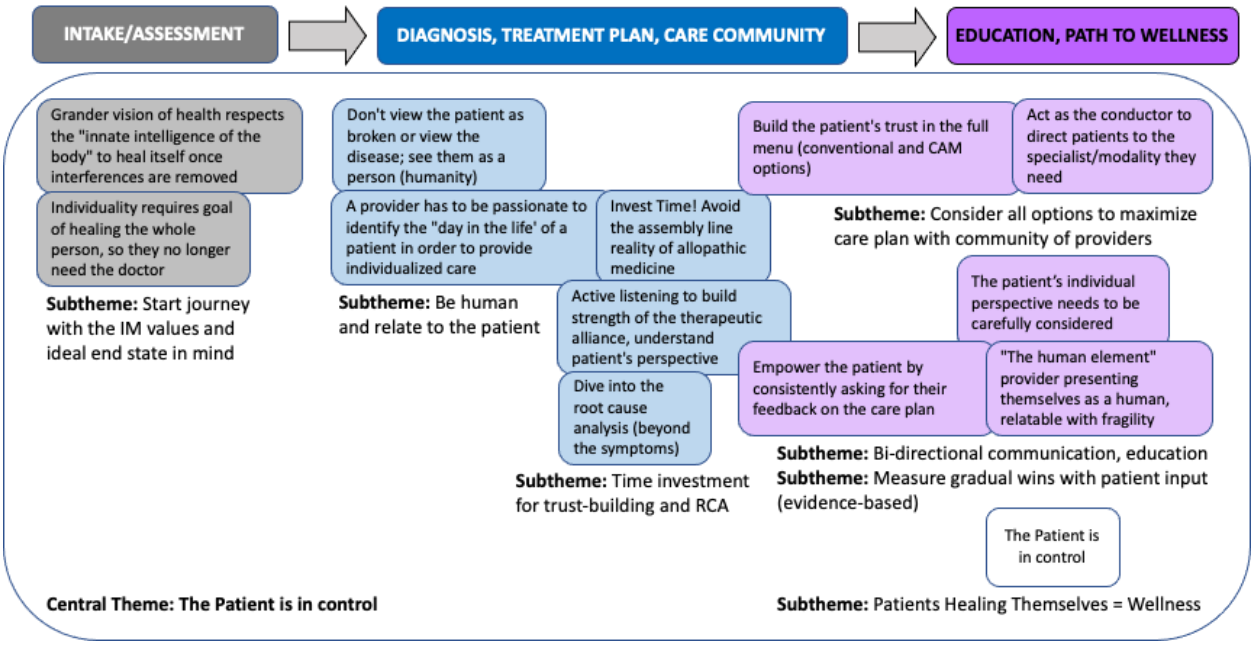


Figure 6: Phenomenological Storyboard

The storyboarding process occurred in an iterative fashion (see Figure J1 in Appendix), allowing repositioning of the essence statements until they fit cleanly within the IM MDM chronology. Where appropriate, related statements overlapped to show relationships. For example, to build trust (purple bubble) providers had to invest time (blue bubble). Each mutually exclusive and comprehensively exhaustive set of essence statements were then described with subthemes. The central theme that resonated throughout the interviews, analysis and coding process was highlighted in the statement: "the patient is in control." The final storyboard told a clear IM story used to develop the phenomenological essence statement.

V.2 Technology: Perceptions of PPA

Each PPA screenshot was described to providers in detail and they responded with their perception of the overall tool, UE, and presentation of information (e.g., what they liked most and least about each of the three visualizations). 183 technology perceptions were captured (see Table J4 in Appendix). The table below included the positive, neutral, and negative gut reactions.

Table 8: Providers' High-Level Perceptions of PPA

PPA SCREENSHOT	PROVIDER PERCEPTION	PERCEPTION OF PPA, UE, PRESENTATION OF INFORMATION
1	POSITIVE	▪ Reminders about patient risk categories help providers avoid failure, catch things they may have missed ▪ EOU: the ability to filter the patient list and view someone's risks organized across one row ▪ "I think it captures some of the pertinent information that we need to know." (MD3)
1	NEUTRAL	▪ Described as busy, containing too much information: "It's not bad. It's a little clunky." (ND1) ▪ "If you have any basic understanding of layout and charts, you should be able to navigate and see what their risk is." (ND2)

		▪ More context is needed: “I would want to know exactly how they evaluate these risk factors.” (DC2)
1	NEGATIVE	▪ Orange and red risk icons: “I probably would make the colors a little bit more distinct…the contrast isn't great enough” (MD1) ▪ Black box presentation of predictions (with limited supporting information) doesn’t support individualized care ▪ Sharing predictions with patients may skew their belief and actually lead to negative outcomes
2	POSITIVE	▪ Consistently described as more pleasant view than Screenshot 1, supporting intake, replacing need to review medical documentation ▪ Summarizes a large amount of data to select the correct intervention, including valuable clinical and socio-economic risk factors ▪ Provides insight on patient’s lifestyle, allowing provider to change how interventions, access to care, resources are shared
2	NEUTRAL	▪ Doesn’t take into account patient presentation, how they are feeling, subjective measures in real time

		▪ "I think the layout of it all is fine." (PA1) ▪ Has value if the care community has access and data entry is completed in a timely manner
2	NEGATIVE	▪ Provider's may be biased by the presentation of socio-economic risk factors, negatively impacting care ▪ User interface needs update: "It looks like you just typed it on Word and plugged it in there. It's just black and white with no spice." (MD3) ▪ "I would have liked to see more of a trend in their experience, and what has already been done for them as it relates to these issues." (DNP1)
3	POSITIVE	▪ Consistently described as more pleasant view than Screenshot 1 & 2, clear organization/grouping of large amount of patient data ▪ Capturing the status of a recommendation provides valuable process/workflow information to providers ▪ Capturing status makes it easier to hold providers accountable for clinical decisions

3	NEUTRAL	▪ Comparing intervention status and downstream outcomes will allow for ML and stronger PPA over time ▪ "It does come across as a little bit busy." (PA1) ▪ Purple color template consistently described as better than Screenshot 1, but slightly difficult to differentiate information on the screen
3	NEGATIVE	▪ Lack of transparency into how the factors impact risk score, inability to drill down into a factor and/or remove a factor ▪ Lack of transparency into the timeliness of assessments/test results and their interpretation by other providers ▪ "This is not tailored towards an alternative health care practitioner like us or an acupuncturist for that matter." (DC1)

V.2.1 *Healthcare Scenarios Best Supported by PPA*

Participants identified 21 Healthcare scenarios best supported by PPA (see Table J5 in Appendix). The most consistent positive attribute was PPA's ability to surface a large amount of patient data quickly. Instead of needing to seek information from multiple charts and/or systems,

providers could quickly view a patient's story on one screen. MD2 described PPA's ability to add efficiency to the MDM process:

"Most [tools] just tell you people's risks, and then you have to figure out the intervention on your own, and you don't necessarily have time to do that with the number of patients you have to see. Listing some interventions that may be helpful, that's key to us actually doing a better job. So that's my favorite part of this."

This ability to aggregate and surface data was described as a key to IM MDM efficiency.

DNP1 felt these tools best supported providers who had less awareness of the contributing factors to health issues and/or those treating patients who had one, well understood condition like diabetes. ND1 confirmed that PPA was least suited for "subjective" issues like pain and most appropriate for disease states with a relatively straightforward paths to diagnosis. In those scenarios, PPA would mimic the documented standards adopted by the medical industry:

"I honestly don't know if this sort of tool would be as great for pain. But in the case of more chronic or somewhat emergent conditions, so like heart disease or diabetes or things of that nature where it kind of is what it is. Like if you're insulin resistant and your cells aren't responding, that is what it is. You are at higher risk for diabetes…or if you do have vascular sclerosis or a family history of heart disease, you are at a higher risk for developing it yourself. Those types of diseases, I think this is more beneficial for."

MD6 also confirmed that PPA was best suited for a subset of disease states:

"Heart disease, that would be a good one, congestive heart failure, if it's hypertension, if it's diabetes. All of those common chronic diseases where we have so many tools already out

there that help us to determine what is the best course of action and treatment. So, I would be trustful…because that's been known for a long time."

ND2 stated, "if I was in more of an emergency situation scenario, then [PPA] might be more helpful."

PA1 negated the idea that PPA was best suited for well-known chronic diseases. She believed PPA had more value for complicated scenarios in which more information could potentially lead to better patient outcomes:

"So complex patients, patients with several comorbidities, patients that…are facing health disparities for whatever reason, a lot of the socioeconomic factors and barriers in health care…education. These are the patients that are kind of falling through the cracks and that we're missing and we're not supporting enough."

MD4 also felt PPA was best suited for complex patients. The system would help providers consider questions or treatment protocols they may not often think about:

"I think it can be useful, especially with patients that present with multiple medical comorbidities, which can cause their treatment plan to get a little messy. Yeah, I think this can be useful as far as helping any provider to remember any aspects of the treatment plan that they may have otherwise missed or did not remember at the moment."

The current limitations of PPA shown below far outweighed the best fit scenarios (or positive perception of PPA).

V.2.2 *Current Limitations of PPA*

Due to the nature of the interview script, participants provided perception of PPA based on the "best-case scenario" or with assumption that the system worked. However, IM providers

identified 54 current limitations that would make PPA unsuitable for the way they practice medicine (see Table J6 in the Appendix). The majority of their doubts fit into four categories:

1. Doubt caused by allopathic nature of PPA (not considering holistic and subjective factors)
2. Doubt about PPA's ability to accurately predict for a unique, complex patient
3. Doubt caused by lack of user visibility into how the system/algorithm works
4. Doubt caused by lack of patient input in system design; no feedback loop in system outputs

Providers were skeptical of PPA because the outputs were delivered without explanation (e.g., in a "black box"). Also, the inability for providers and patients to weigh in on the predictions/recommendations or change the weighting of clinical or socioeconomic factors was seen as a major limitation.

MD4 described PPA limitations to support his psychiatric practice: "A lot of the mental health evaluation involves communication. And because most of communication is nonverbal…there's really no way a computer-based algorithm is going to be able to account for [that]." Also, DNP1 uncovered another limitation in PPA's access to patient records:

"Mental health, their records are…sealed for privacy reasons. You really don't get any information from that visit unless the patient tells you what was discussed or what they're working on."

PA2 and MD2 felt PPA may not be feasible for patients who require a surrogate "who's making decisions for [them]" or need an interpreter. Ensuring proper data entry in those scenarios would require more time than usually available during primary care visits. MD5 exposed how PPA would not work for her unique patient populations:

"If we plug a laboring pregnant patient into that model…they're all going to screen positive for potential sepsis because all of them are tachycardic. Most of the pregnant women on labor and

delivery would screen positive for sepsis just at a baseline…So I think it's important to make sure that the screening systems are adjusted…to make sure that your patient actually fits the algorithm that's being used."

DNP1 described other barriers to care that PPA may not currently address in their algorithms: "psychosocial or social economic issues," being underinsured, limited access to medications, homelessness, and other needs that are handled by social workers and case managers. Those barriers would negatively skew a patient's ability to beat chronic pain regardless of their PPA predictive scores.

V.3 Future IM and PPA Convergence

This future-focused research challenged providers to think ten years out and consider if PPA will one day be applied to IM practice. Participants identified 70 values, attitudes, and beliefs toward PPA (see Table J7 in Appendix). The table below highlights their attitudes toward PPA (positive, neutral, or negative), their expectation on future convergence between IM and PPA (Yes, Maybe, or No), and key beliefs about PPA.

Table 9: Perceptions Toward IM and PPA Convergence

PARTICIPANT	ATTITUDE TOWARD PPA	WILL IM & PPA CONVERGE?	IM PROVIDER BELIEFS ABOUT PPA
ND 1	NEUTRAL	YES	▪ PPA needs overhaul for application to NM
DC 1	NEGATIVE	MAYBE	▪ PPA is potentially dangerous due to

			negative impact of data inaccuracy
ND 2	NEUTRAL	MAYBE	▪ PPA is impractical for managing holistic nature of NM
MD 1	NEGATIVE	YES	▪ PPA is detrimental for IM if it doesn't support individualized care
DC 2	NEUTRAL	YES	▪ PPA is irrelevant for providers who use "hands-on" physical assessments
MD 2	POSITIVE	YES	▪ PPA is more accurate than human intelligence
MD 3	POSITIVE	YES	▪ PPA identifies options providers may miss and can track the care plan over time
PA 1	NEUTRAL	YES	▪ PPA will take >10 years of technology evolution to properly support IM
DNP 1	NEGATIVE	MAYBE	▪ PPA raises awareness of CAM options, but risks

			limiting provider autonomy
MD 4	NEUTRAL	YES	▪ PPA doesn't measure subjective factors and is unfit for mental health providers
PA 2	NEUTRAL	YES	▪ PPA needs refinement to explain "why" recommendations are provided
MD 5	NEUTRAL	MAYBE	▪ PPA doesn't consider PRO or complexity of real-time data
MD 6	POSITIVE	YES	▪ PPA is best fit for chronic diseases with well defined-treatment protocols

Amongst the five providers with some PPA experience, the only two who viewed the technology positively worked in a hospital setting where the use of EMR and PPA was mandated. They both believed systems designed for allopathic care are more easily adopted by hospitalists and/or providers who perform more invasive steps like mental health crisis stabilization, controlled substance management, emergency care, and surgery. While only three

providers had positive attitudes about the use of PPA, the belief that convergence would eventually occur was unanimous across study participants

DNP1 was the only provider with previous PPA experience who viewed the tool in a negative light. She felt dependence on these tools could erode critical thinking skills and/or remove autonomy from providers over time:

"I don't want it to get to a point where [PPA] is taking the discernment…the ability for the provider to think outside of the box and to really holistically look at the situation because they're relying on this."

And MD1 felt that regardless of functionality PPA was totally unfit for IM practice:

"It's very impersonal. I think that this is the problem with medicine today…people are trying to put patients into a diagnostic pigeonhole, and that's why they're not getting better. Because it just doesn't work that way. I mean, there's not one person that's the same as the next person. And so, this whole idea of treating a diagnosis or a symptom as opposed to the person, is what we're trying to get away from with integrative medicine."

Even providers like MD4 who positively described the presentation of a complete patient snapshot did not feel PPA added value above and beyond his own intuition/expertise:

"[PPA] probably wouldn't be something that I would need at the moment. Don't mean to toot my own horn, but I feel like I've gotten pretty good at doing a safety risk assessment… recognizing if someone needs to go to the hospital or not."

And even when considering a future state system with high TTF, DC1 believed the "human element" of introducing error and chaos would still occur. Regardless of their values, attitudes, and beliefs toward current state PPA, all practitioners identified many changes or future state requirements needed for the emerging technology to fit their ways of working.

V.3.1 *Proposed Modifications to PPA*

Providers proposed 133 modifications to PPA, including additional data inputs & outputs (see Table J8 in Appendix). For PPA to be applied to IM in the future, the PPATech system needed to meet the textural and structural tasks identified in the first half of the interviews. This required the system be integrated with EMR/EHR and mirror their functionality: allow for data input, analysis, and reporting. Three major areas of PPA innovation emerged, shown below as capabilities (desired outcome for IM MDM) and functionality (desired tasks performed by PPA):

Table 10: Three Major Categories of PPA Innovation

FUTURE PPA CAPABILITY	FUTURE PPA FUNCTIONALITY
Surface Healthcare Big Data	▪ Effectively and securely surface historical and real-time data from multiple sources across the community care, state systems, Medicare, EMR/EHR, ePRO systems, etc.
Center Around the Patient	▪ Surface a list of allopathic and CAM referral options; support bi-directional communication and collaboration on the patient care plan across the community of care
Measure Path to Wellness	▪ Track a dynamic care plan with "center of gravity" or QOL goals, objective and subjective clinical factors, and patient input/feedback clearly identified

Participants described the need for multiple data types (historical information, EMR/EHR data, real-time patient data) to be made available in one future-state system. DNP1 believed over time PPA would become a "connected system, where my clinic, your hospital, a competitor

hospital…somewhere where I can go and quickly get the information [on] the patient in my office right now." MD2 added that IM providers should have quick access to patient screening information via a connected app.

Providers widely believed the future state technology should adopt a patient-centered approach. DNP1, MD2, and MD3 mentioned that patients should have access to their records and perform data entry at home, requiring internet and/or mobile service. MD 5 also described patients as a future end user of PPA (along with the care community):

"If you can use the PPA to have more patient input into it, right, so that they can actually help provide some of that data, then I think PPA could definitely apply to integrative medicine. But if you're relying on an external source to kind of plug [data] in based on what they think the patient has said or what [the system] thinks should happen, then…you lose that integrative aspect."

MD2 believed patient use of PPA could impact the referral process:

"Maybe the patient can list attributes that they would look for in their providers…we could have a list of the questions to ask the patient what [they are] looking for; if we could refer you to a provider, geographic location, just a few things to see what would make them more comfortable. And we would help them to follow up and actually go to the visit or go to the provider."

Beyond the referral, future state PPA would also need to support the specialist protocols based on industry guidelines (which are constantly shifting). MD3 expected PPA outputs to mirror the guidelines of the National Surgical Quality Improvement Program and be updated periodically.

Providers expected the functionality to drill down into the details to understand why the factors led to a specific recommendation. Instead of static screens, IM providers required the ability to examine information with various levels of granularity (e.g., hovering over a clinical risk factor or recommendation should provide additional details). Clicking on the name of a member of the

care community should surface details about their location, medical specialty, and any diagnoses and charts generated while the patient was in their care.

The ability to review a comprehensive list of allopathic and CAM modalities and accept/reject options was identified as valuable, missing functionality. PPA should supplement the list of medication, treatment, and intervention options with links to educational content that allows practitioners to research and grow in their understanding of IM. MD2 wanted future systems to not only monitor holistic factors but also provide alerts when the dynamic pain contract was broken by the patient.

In addition to key areas of innovation and aspirational functionality, providers described the importance of shifting the UE to support "eye contact" with patients. MD3 mentioned the inherent value of interpersonal connection in the patient-provider relationship:

"You cannot lose the art of human interaction. If that's the case, you might as well just sit me in front of a screen and ask me a couple of questions and now I'll just talk to the screen and the screen [will] record it. Then you don't need to see the physician - you know what I mean - if we're not going to interact with the patient."

Participants balked at the idea of transcribing data into yet another SaaS platform. Future state PPA systems should support dictation and other features to remove the administrative burden where possible, allowing providers to be more present during patient visits.

Finally, bias was described as the most critical pitfall that future PPA should mitigate. Systems should support de-selection of a clinical or socioeconomic factor the provider does not think should be included in the algorithms calculating risk. Certain content should be blinded to reduce the introduction of unnecessary data. While considered in the PPA algorithm, certain data may not be appropriate to show to providers seeking to give individualized care.

VI DISCUSSION AND CONTRIBUTIONS

The phenomenological approach provides an in-depth look into the experience of the IM community of care for patients suffering from chronic pain. Reactions to three PPA screenshots (showing real-world data) allow for extrapolation of how PPA tools can be transformed to meet the unique needs of this medical community. Readdressing the research question, yes, PPA can support and innovate IM once significant changes are made to serve the unique needs of patients, providers, and the extensive community of care.

VI.1 Comparison of Empirical Findings to the Literature

The qualitative data confirms the value of IM as an alternative to allopathic medicine. (Oberg et al., 2015). This section will address the three, secondary research questions with comparisons to learnings from the literature review.

1) How does this group of professionals describe the tasks they consistently perform (e.g., the steps in evidence-based MDM?

Moving beyond a static list of tasks, the phenomenological approach illuminates the gradual nature of MDM and the deeper relationship between patient and provider found in the literature (Amy Neil MS, 2019; Coulter, Snider, & Neil, 2019). Study participants adamantly describe IM as the only path forward for meeting the growing need for individualized care and improving the health of U.S. citizens.

Results include a detailed review of the technology, including PPA Perception by Screenshot, Scenarios Best Supported by PPA, and Current Limitations of PPA.

2) How does this population perceive the PPA technology currently being used in U.S. hospitals to predict patient outcomes and provide recommendations to providers?

Providers confirm the literature's view that medical practitioners experience algorithm aversion and tend to reject the use of AI for critical MDM (Dietvorst, Simmons, & Massey, 2018). Thus, study participants recognize nearly double the PPA limitations compared to scenarios within which the technology supports healthcare. Practitioners also paint a consistent picture of the complexity of treating HICP and chronic pain, conditions that may have multiple underlying causes and no ultimate "cure" in some cases (Schneiderhan, Clauw, & Schwenk, 2017) (Lin et al., 2017). The lack of peer-reviewed articles about algorithms that take into account multiple systems or subjective factors further explains providers' negative perceptions of PPA. Algorithms for chronic pain that tend to focus on one scale or operate physiological system-by-system may lack the complexity to make accurate recommendations (Mueller-Peltzer et al., 2020). The technology simply hasn't evolved to meet IM needs.

Study participants' values, attitudes, and beliefs were skewed, with the unanimous prediction that future convergence between IM and PPA is highly likely.

3) How can an understanding of current IM practice be used to identify the potential usefulness of PPA and high-level future requirements?

Participants need functionality across the entire spectrum of technology sophistication found in the literature: descriptive, predictive, prescriptive, and autonomous analytics (Oesterreich et al., 2020). In addition to the eight use cases for PPA in Healthcare described in the literature (Oesterreich et al., 2020), participants expect the future state to also support the following: ***Engage Care Community***, ***Manage Ongoing Education*** and the expansion of the health monitoring use case to include tracking subjective factors, diet, behaviors, and lifestyle changes. And all providers stress the need for future state PPA to present data in an ethical manner that does not introduce bias to providers or negatively influence the care offered to patients (Noble, 2018).

VI.2 Essence of IM

I have 20 years of professional experience in business development, management consulting, and program/project management in the Healthcare and Life Science space, including work with the largest Biopharmaceutical companies, small technology start-ups, insurance payers, and hospitals. I also studied the clinical pathways of gastrointestinal, cardiovascular, respiratory, and mental health drugs. My understanding of the nature of holistic medicine pales in comparison to my experience working in spaces that embrace allopathic medicine, mechanism, and pharmaceuticals as the first response to managing patient symptoms.

Collective experiences as a practitioner create biases. I expect end users to adopt technology and/or for the proposed technology to fit the business and technical needs of the audience. It is surprising when participants' responses move beyond a yes-or-no response on the acceptance of functionality; and instead include a visceral response as to why they fear future convergence. PPA fundamentally does not work for the way they practice.

Finally, my lived experiences as a Black man in the U.S. create additional sensitivity toward certain topics. I have studied our Public Health system and the disparities that negatively impact underrepresented groups. This may affect how I receive anecdotal data about provider bias, access to healthcare, and the socio-economic determinants to health. Within this human context, I used methodology exercises like memoing and systematic coding of providers' stories to confront and reduce my personal bias. Then, I performed horizontalization and used phenomenological storyboarding to draw out the providers' true voice and identify the essence of IM:

Integrative medicine is medical practice that seeks to place the control of health in the hands of the patient. The patient-provider journey starts with acknowledgement of the end goal: heal the whole person using the innate power of the mind, body, and soul. Providers use a

compassionate approach to affirm the patient's humanness instead of viewing them as broken or diseased. Significant time investment is made to build a trusting relationship; understand the patient's daily life and expected outcomes; and perform root cause analysis to identify source(s) of the presenting condition(s). Providers consider a comprehensive catalogue of conventional and CAM modalities while collaborating across a diverse community of care (e.g., physicians, naturopaths, nurses, psychiatrists, pharmacists, social workers, and many others). Patients are encouraged to have bi-directional communication in which they learn about different treatments and discuss their comfort level with each option. This evidence-based practice tracks objective and subjective clinical measures over time along with gradual lifestyle, behavioral, and dietary changes. Finally, the IM provider practices humility; openly expressing learnings from the approaches that failed and succeeded; and improving upon the dynamic care plan until the patient achieves sustained wellness.

VI.3 Future-Focused Task-Technology Fit and Impact on Algorithm Aversion

FFTTF is a new theoretical model to identify the potential fit between tasks performed currently and emerging technology.

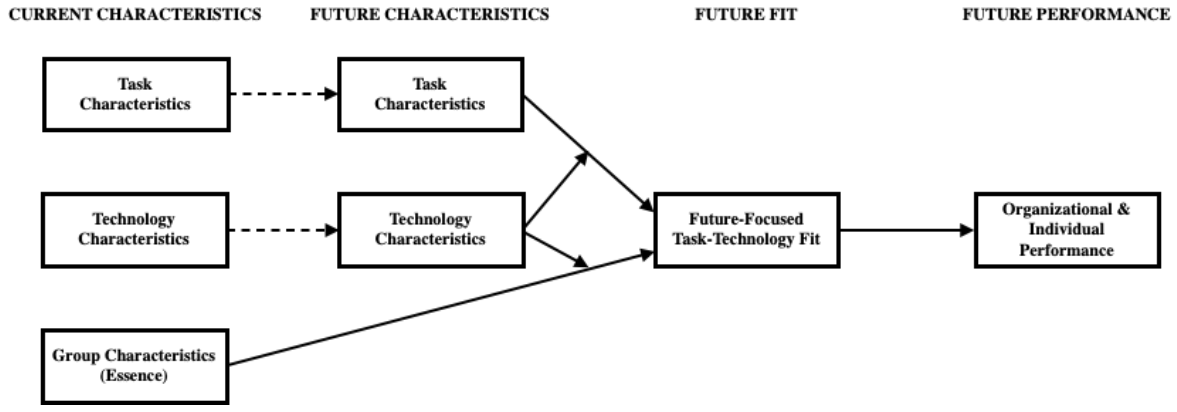


Figure 7: Future-Focused Task-Technology Fit Model

The figure above adapts Goodhue's 2000 model to include future characteristics, fit, and performance (Goodhue et al., 2000). The FFFTF model includes the following elements:

Table 11: Elements of the Future-Focused Task-Technology Fit Model

FFTTF ELEMENT	DESCRIPTION
CURRENT CHARACTERISTICS	
Task Characteristics	▪ Textural and structural description of tasks performed ▪ Same as Goodhue 1995, 2000 description
Technology Characteristics	▪ Description of technology capability/functionality ▪ Same as Goodhue 1995, 2000 description
Group Characteristics	▪ Nuanced description of what a group does and how they do it ▪ Essence identified using a phenomenological approach
FUTURE CHARACTERISTICS	
Task Characteristics	▪ Future tasks that a group is expected to perform ▪ Expected process transformation caused by future conditions
Technology Characteristics	▪ Ideal future state technology identified by end users ▪ Expected updates to UE, capability, functionality
FUTURE FIT	
FFTTF	▪ Ability for emerging technology to support task characteristics ▪ Ability for technology to support unique group characteristics
FUTURE PERFORMANCE	
Organizational & Individual Performance	▪ Expected output of a group's adoption of emerging technology ▪ Impact of technology on an individual's ability to execute work

The current task (IM MDM) and technology characteristics (PPA) are the same elements described in the original Goodhue model (Goodhue, Klein, & March, 2000). Group characteristics (essence) is the nature of medical practice identified using the phenomenological approach that should be consistent across IM providers. Essence, the innate nature of how IM provider's care for patients, is not expected to change over time. Future task characteristics include any additional or steps or process changes a group is expected to perform in the future. For IM providers the core set of tasks would not likely change dramatically. However, there may be nuanced changes to their

workflow as future tasks are impacted by new technology, regulations, and/or business practices. This expected shift between current and future task characteristics is represented by the dotted arrow.

Future technology characteristics (capabilities and functionality) are elicited from the qualitative interviews:

- Capability-ability of the technology to maximize positive healthcare outcomes
- Functionality-ability of the technology to execute operations, tasks, functions

This wish list represents the ideal future state to support identified tasks, to overcome the negative perceptions of the technology and maximize the scenarios in which it would be best suited. The dotted arrow between current and future technology characteristics represents the multiple pathways to change: incremental development over time versus innovation/industry disruption.

Innovation and design thinking requires a willingness to transform the current ways of working, developing technology with the future in mind, while supporting the innate values, attitudes, and beliefs of IM providers. FFTTF is the measurement of how well an emerging technology meets the task characteristics of a group. Technology characteristics act as a moderator for the impact task characteristics and group characteristics have on fit (represented by solid arrows). High FFTTF would occur once the technology is designed to provide the expected capabilities/functionality and meet the innate needs of a group of end users (e.g., is a fit for their essence).

The final element is group or individual performance. Similar to the Goodhue model, FFTTF predicts organizations will operate with greater effectiveness and efficiency when emerging technology supports task characteristics and group characteristics. This relationship is

represented by a solid arrow. As FFTTF increases, so should user adoption of technology and performance.

Surprisingly, after hearing how PPA is currently being implemented in a few U.S. hospitals all providers believe convergence with IM in the primary care setting is inevitable. This belief occurs regardless of their experience with these tools or personal perception about the technology. However, the data suggests that even in a future where PPA is designed to meet the needs of IM, the technology will not be easily adopted. IM providers list several factors that increase their algorithm aversion or likelihood of not adopting PPA:

- Low TTF to IM practice
- PPA's black box nature (e.g., no explanation about outputs)
- The critical nature of their practice (e.g., life or death decisions)
- The complexity of managing multiple modalities
- Their specific practice is more subjective (e.g., hands-on providers, psychiatry, etc.)

Figure 8 proposes a relationship between FFTTF and providers' attitudes toward PPA:

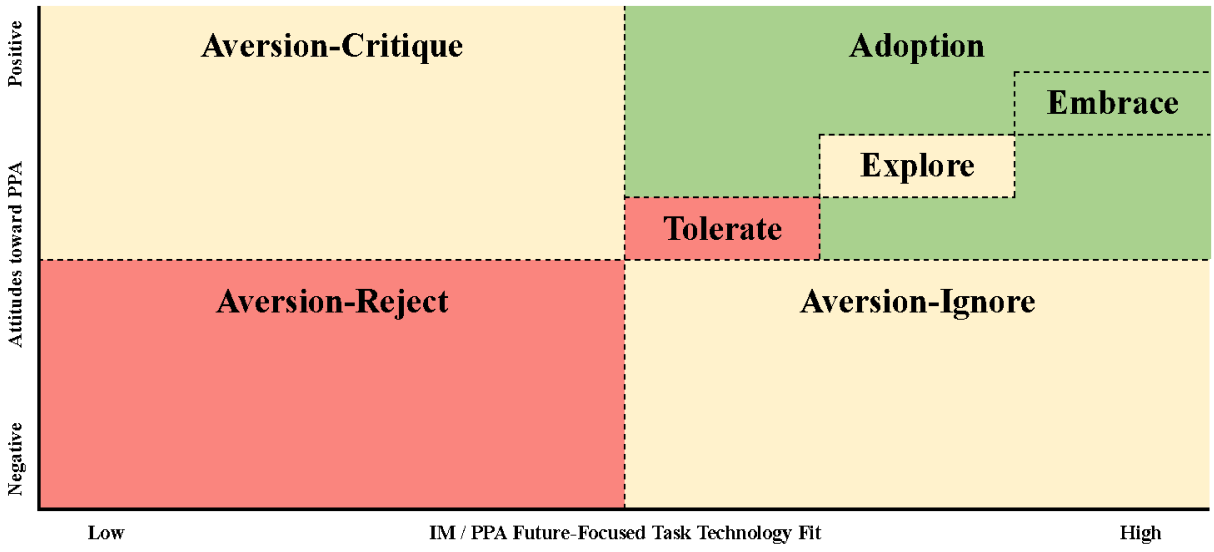


Figure 8: Providers' Expected Intentions, Attitudes toward PPA versus FFTTF

The left side of the two-by-two diagram represents low FFTTF. In its current state, PPA is unfit for the way IM providers provide care. For the majority that hold negative attitudes towards the technology, they would reject PPA outright. Providers with more positive attitudes would critique the technology. Algorithm aversion would occur in both cases of low PPA fit.

The right side of the figure represents a future state where PPA has developed to have a higher fit for IM. If provider attitudes remain negative, they will ignore PPA and not use it unless it is explicitly mandated by their employer. Algorithm aversion may still occur because providers don't trust the emerging technology to meet the underlying needs of their group characteristics (Dietvorst, Simmons, & Massey, 2018). More simply, AA may trump FFTTF in populations that have very complex MDM processes and are more apt to depend on their training, expertise, and intuition.

The upper right quadrant represents the stepwise nature of overcoming algorithm aversion. Adoption will require high TTF and a gradual path to more positive attitudes about PPA. Providers will first tolerate the emerging technology, then begin exploration in practice, and finally embrace these tools. We would expect behavioral intention to use PPA to increase if provider's perceived high levels of behavioral control (Suryaningrum, 2012). Many providers hold concerns that adoption of another technology would introduce additional burdens and reduce their self-efficacy. Future state PPA must increase providers' confidence in their decision-making (with access to the right information to influence behaviors) and allow them to feel they still control the path to wellness.

Reapplying the Suryaningrum model, when FFTTF is high the following five steps must be taken to reduce algorithm aversion (Suryaningrum, 2012),:

1. Include providers in PPA design sessions to maximize UE and increase overall EOU

2. Socialize system usefulness and fit to provider's task characteristics via training
3. Socialize accuracy of the system with transparency about any risks to patients
4. Socialize how provider's values and ways of working are supported by PPA
5. Socialize efficiency gains and improved patient outcomes caused by PPA utilization

Using the FFTTF model to direct innovation, adoption will occur faster as the future state technology is developed with the essence of the end user in mind.

VI.4 Innovation Framework: Patient-Centered PPA for IM

Healthcare IT innovators have a unique opportunity to aggressively traverse the dotted arrow between current and future technology characteristics in the FFTTF model. A design thinking approach will be required to develop software which fits the specific needs of IM practitioners and the multitude of IM textural and structural tasks. The innovation framework proposes to shift the paradigm of PPA to a patient-centered tool that manages a complex data ecosystem, designed for the various protocols of the extended community of care, while tracking the individual's dynamic care plan over time.

The PPA Innovation Framework consists of three capabilities (beneficial outputs of the system) supported by technology functionality and an intuitive UE: Surface Healthcare Big Data, Center Around the Patient, and Measure the Path to Wellness.

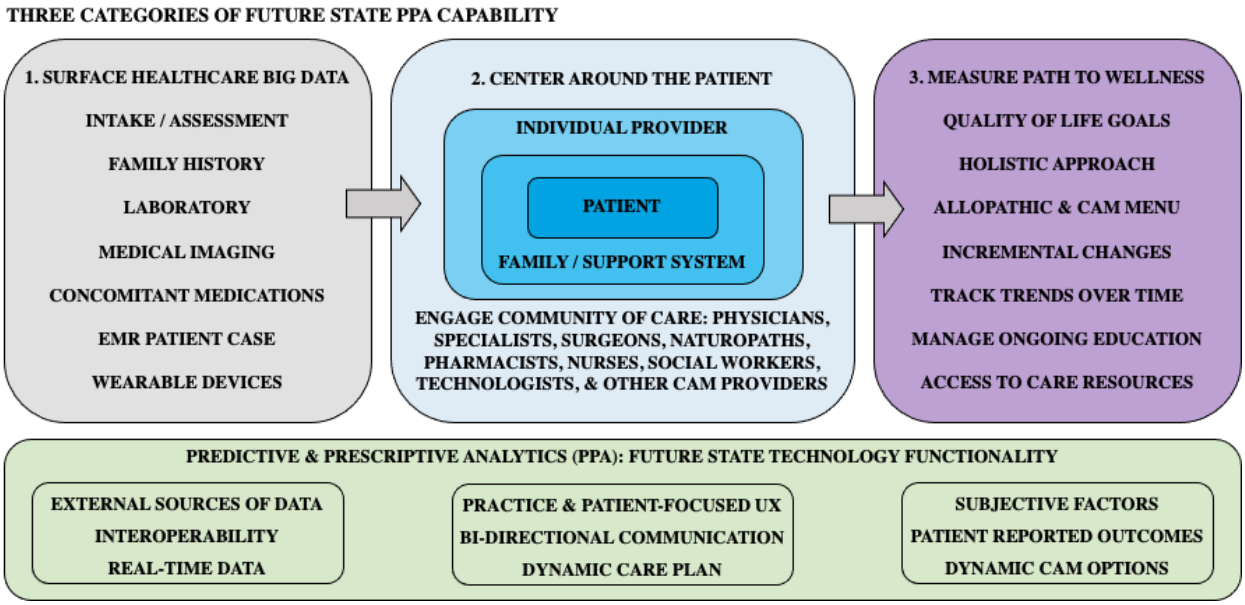


Figure 9: Innovation Framework: Patient-Centered PPA for IM

VI.4.1 *Capability 1: Surface Healthcare Big Data*

PPA must manage the diverse types of information captured during the intake/assessment process like family history, allergies, personal history and other content found in EHR. Laboratory results and very large digital image files will provide the data needed for providers to confirm or change the diagnosis using an evidence-based approach. Information about concomitant medications is necessary to understand how prescribed remedies will react with any products the patient is currently taking.

Portability of healthcare data from a growing number of external sources (e.g., provider systems, state systems, hospital records, etc.) will require interoperability across the multiple organizations that own the information (e.g., healthcare systems, insurance payers, healthcare exchanges, and others). This new way of recording, maintaining, and surfacing data will require strict data privacy/security rules to be compliant with current federal and state laws and regulations. This list includes but is not limited to:

- Health Insurance Portability and Accountability Act (HIPAA) for the protection of patient data and privacy
- Centers for Medicare & Medicaid Services (CMS) Interoperability rule for patient access to data collected across platforms
- State and Federal Privacy Laws to protect consumers and provide transparency into how healthcare organizations and companies use and/or sell personal data (e.g., California Consumer Privacy Act (CCPA) or the General Data Protection Regulation (GDPR) if managing data from European Union citizens)
- U.S. Food and Drug Administration (FDA) 21 Code of Federal Regulations Part 11 for management of electronic records and signatures
- Federal Medical Device regulations for management of Mobile Health applications like wearables and health tracking apps

Interoperability requires data sources to be well defined (preferably with published and widely adopted data standards) and for the owners to make the aggregation of information readily available and easy-to-understand for the end customer-the patient. Complexity increases as unstructured data and data formatted inconsistently between different systems become necessary pieces of the IM puzzle. This will include capturing and sharing subjective data like a pain scale measured from a frowning face (high pain level) to a happy face (low level). Combining data from multiple providers (potentially from multiple states) into one record creates serious challenges, especially when data across systems is incongruent, follows different data standards, or is not easily exported and shared securely.

If someone is admitted to the hospital, PPA would need to link the data found in the patient's primary care system(s) to the EMR case. Providers in the inpatient, emergent care

system will need to understand what historical decisions were made by IM providers. Once released from the hospital, the EMR record should be surfaced to the primary care provider. A drop-down menu that allows the IM provider to quickly digest the history of diagnosis (across multiple providers) will become an integral part of the patient historical record. PPA should also connect with pharmacy systems to understand prescribing patterns over time and track compliance with medications, supplements, herbs, and other treatments.

Wearables that collect data which could impact diagnoses and/or influence medical decisions must undergo federally-regulated medical device clinical trials. Devices like glucometers, heart monitors, and popular wearables like the Fitbit™ or Apple Watch™ collect data that is not currently used by PPA algorithms. However, this data is extremely valuable for understanding the patient experience once they leave the care setting. Future state PPA must incorporate ubiquitous health data to truly promote measurement of the impact of lifestyle and behavioral changes.

This capability also requires access to real-time data. Providers are more apt to accept PPA if they trust the algorithms are considering the best information available. Providers need visibility into the timeliness of the clinical factors, including trend data on laboratory values over time. PRO like the elements of a mental health screenings may require more frequent data collection and updating in the system.

VI.4.2 *Capability 2: Center Around the Patient*

The second capability represents a fundamental shift from how PPA systems are currently designed. If the true customer of healthcare is the patient, then future state systems must consider them as the primary end user of the technology. This significant change would

require the presentation of health information in simplified language based on the average reading level of the U.S. population (e.g., sixth grade level). Also, developers should consider new visualizations and/or gamification to help patients connect their individual actions, compliance, lifestyle changes to measurable health outcomes.

Patients will identify their health issues, goals, and comfort level with the treatment options presented by providers. They will confirm the accuracy of data included in their health record, creating a golden record that may be shared across systems. Patients will also confirm, reject, and/or update their socio-economic risk factors which are currently limited to the opinion/perspective of the nurse/provider conducting the intake/assessment. This would allow providers to review pre-screen data and medical history during the assessment visit instead of asking a redundant list of questions and wasting time transcribing answers into a system. Patient ownership and validation of health records would allow providers more time to focus on care versus data entry.

When appropriate, the patient's family, support system, and primary care provider would gain access to a subset of the patient's PPA medical chart/record. Patients would also grant permission for their key provider or "conductor" to allow others in the community of care to view all or parts of the health record. The identified provider would tag a potentially large list of professionals: physicians, specialists, surgeons, naturopaths, pharmacists, nurses, social workers, technologists, and other CAM providers. This capability will require PPA to validate provider golden records to ensure only the correct professionals gain access.

This advanced accessibility functionality will require a rights and roles-based system in which patients (or surrogates) and providers identify who can view data. Patients would "own" their master record but others' access would be revoked due to a myriad of reasons (e.g., patient

changes provider, outcome of a legal issue, patient becomes legal age of adulthood and parents/guardians can no longer view data). Protecting patient data with varying levels of permissions and controls would include the formidable hurdle of following the data privacy laws of different states and the Federal government.

Referrals to new providers would be managed via PPA and the community would be alerted as individuals are added or removed from the care team. The system would flag any providers with past issues of malpractice, patient complaints, an/or who have their medical license revoked. The extended Community of Care would have bi-directional communication through PPA and collaborate on the patient's dynamic care plan. They would add recommended CAM modalities and behavioral, diet, and lifestyle changes to the plan with explanations as to why they were considered.

Future PPA technology cannot be a point solution that simply captures rows of information (e.g., paper forms) on screen. The UE must be practice- and patient-focused to meet the needs of the diverse providers in the community of care. Developers should avoid workflows that create unnecessary distractions or depend on unreasonable amounts of transcription, which effectively reduces the amount of time for true patient-provider connectedness. The PPA user interface should only surface the information used by that provider type or specialty. We would expect the information surfaced to a surgeon preparing for a highly invasive procedure to differ significantly from a sports medicine provider using hands-on assessments of their patient's function post-surgery.

A truly patient-centered system must address the curation of a dynamic care plan with shifting patient-provider expectations and medical realities. PPA will track patient acceptance or rejection of the elements of the care plan, creating a new set of factors to train the algorithms.

The resultant metric, "likelihood of patient adoption," could help providers understand if their patients are apt to accept a new recommendation or modality compared to those suffering from a similar set of conditions. "The patient is in control" was the central theme of IM. So, health-focused technology must be designed to empower patients to achieve the third capability, Measure Path to Wellness.

VI.4.3 *Capability 3: Measure Path to Wellness*

The path to wellness starts with the IM theme that providers must understand the patient's "center of gravity." The patient's extremely personal QOL priorities should be made visual in PPA with constant reminders for the care team. In order to gain patient trust and improve the probability of compliance, providers will suggest gradual changes, track incremental progress, and encourage patients to remain steadfast to meet their health goals. PPA will track subjective and objective measures along with PRO, to train and improve the algorithm (ML).

PPA workflow must mirror evidence-based medical practice, with the ability to inform medical decisions using point-in-time data and medical trends over time. Providers will be able to visualize trends in clinical factors. They will receive healthcare trend alerts when conditions have worsened, laboratory results or digital images are abnormal, or positive progress occurred past certain patient- and provider-defined thresholds. For example, if a 75-year old patient were no longer able to play with her grandkids without experiencing back pain, her subjective diary entry for pain in her PPA app would be low, triggering some action for her primary care doctor, chiropractor or physical therapist.

PPA will need to capture PRO, data captured from devices or mobile apps. To avoid inequity, more U.S. citizens will need access to technology, mobile devices, and internet connectivity to use

devices at home. In this innovation framework, patients would be expected to enter in their information and/or confirm the following types of data:

- Behavior and lifestyle in a patient health questionnaire (PHQ)
- Objective mental health factors like hospitalization frequency
- Subjective factors like pain scores over time
- History of past & current medications
- Current physical symptoms and adverse events

Capturing compliance promotes patient accountability. If a patient is struggling to follow the care plan or breaks his/her pain management contract, the PPA should alert the correct doctor, social worker, or other appropriate professional. This visibility into patient activity could prompt a care worker to perform a wellness check, call the patient, verify the reason for noncompliance, and update the care plan. Studying correlations between provider recommendation and patient compliance could also provide insights into patients' values, attitudes, and beliefs about lifestyle change and CAM adoption.

Supporting a holistic approach will require systems to categorize predictions and recommendations into the mind, body, and spirit buckets. The new prescriptive menu will include the most-updated and research-supported allopathic and CAM modalities with some visualization of the invasiveness of each option. This advanced capability will also provide alerts to providers, identifying naturopathic, herbal, and botanical options and reducing the negative impact of prescribing the wrong pharmaceutical agents. There may be a secondary benefit that allopathic providers may learn more about the holistic patient with exposure to previously unknown treatment options and relationships forged with IM/CAM professionals.

PPA will get smarter by identifying correlations between evidence-based practice, lifestyle and behavioral changes and the resultant improvements to health, vital signs, and other clinical factors (see Autonomous Analytics below). Over time, we would expect the menu of CAM recommendations to expand and contract based on data captured in subsequent visits, on patient reported apps, via biometrics and other forms of real-time data.

Options will be surfaced concerning the patient's access to care. Social workers and case workers will populate a dynamic list of next steps once the patient is released from the hospital or receives a diagnosis from the primary care provider. This information will include transportation options, coupons and rebates for medications/care expenses, and other necessities for patients who may have different levels of mobility, financial stability, and family/support systems.

Finally, future PPA will provide education to patients and providers about predictions, recommendations, and interventions. This information will be easy-to-digest for patients and their families in the form of short articles, expert videos, and multimedia infographics and animations. Education will include content for patients to better correlate lifestyle changes to positive health outcomes. Providers will receive links within the patient chart to peer-reviewed articles, industry conference presentations, disease state guidelines, and treatment protocols. As this bolus of information evolves, providers will be exposed to content that challenges them to learn and educate their patients about the most effective allopathic, IM, and CAM options.

VI.4.4 *Autonomous Analytics in Healthcare*

The FFTTF model offers researchers and practitioners a path to innovation by considering the wealth of opportunity between current and future technology characteristics. The literature defines the emerging level of Big Data sophistication as autonomous analytics

(Oesterreich et al., 2020). Future AI deep neural networks will gradually develop the many layers of the IM MDM process across multiple physiological systems to identify patterns that we as humans simply cannot (Chin-Yee & Upshur, 2019) (Miner et al., 2014). The table below

Table 12: Autonomous Analytics Applied to PPA Innovation Capabilities

PPA INNOVATION	APPLICATION OF AUTONOMOUS ANALYTICS
Surface Healthcare Big Data	▪ Identify missing data sources that negatively impact the algorithm and revalidate system accuracy ▪ Educate providers on the collective impact of data sources ▪ Allow providers to build, test, and train their own models, incorporating data sources supporting provider-unique protocols ▪ Identify issues of latency, and the impact of not having real time data on system accuracy ▪ Risk factors identified by the data prompt the system to recommend additional laboratory tests
Center Around the Patient	▪ Suggest subjective factors to collect from patients ▪ Identify barriers to care based on patient parameters ▪ Predict impact of case and social workers resources on patient outcomes ▪ Identify additional providers to add expertise/medical specialty to the community of care
Measure Path to Wellness	▪ Identify patient education needs and their understanding of CAM options, lifestyle and behavioral changes ▪ Design a dynamic care plan with “center of gravity” or QOL goals ▪ Identify the objective and subjective clinical factors to track based on patient population and wellness goals ▪ Analyze the risk of making recommendation patients do not understand or accept and inform providers on the need for patient education ▪ Recommend stabilization and placement options for patients presenting in a mental health crisis ▪ Recommend less invasive or more invasive treatments based on risk levels set by patient and provider ▪ Update algorithms based on provider feedback on clinical and socioeconomic risk factors ▪ Update algorithms based on and patient input/feedback on health goals, compliance levels, and health outcomes

Autonomous analytics will empower the technology to learn from historical patient data and apply combinations of treatment, CAM modalities, and lifestyle change across different populations and levels of wellness. Within a certain degree of statistical significance, sophisticated technology will apply learning from chronic pain to lupus patients or another condition(Creswell & Poth, 2016). (Creswell & Poth, 2016).. Correlations between the combination of intermittent fasting, proper hydration and supplements to decrease inflammation in pain patients may be modeled against diabetic patient data, creating new, evidence-based treatment protocols.

Ideally, future state systems would surface a prediction, a recommendation and a "second opinion." The Healthcare IT community must move beyond "black box" PPA toward autonomous analytics systems that allow for dynamic algorithms (Miner et al., 2014). Imagine a feedback loop within which providers can accept or reject the factors used by PPA. Providers want to understand how removing a factor or changing a subjective score impacts system recommendations. If the end user changes the elements included in the algorithm using the drag-and-drop functionality (e.g., intuitive workflow), the system should educate her or him on the potential impact to the patient. The new prediction, recommendation, or interventions could be displayed with a color code or numeric grade to denote the new level of accuracy. The future of second opinions may be achieved by autonomous analytics' ability to make accurate predictions and recommendations within differing sets of MDM parameters and/or medical protocols.

Autonomous analytics will incorporate a feedback loop between the diverse community of care/patient support system and the technology. As providers add or remove factors from the menu, a sophisticated system may ultimately state that no statistically significant prediction or recommendation can be made within the self-selected parameters. Providers would review the

audit trail to the original algorithm to understand how changing factors impacted predictive and prescriptive results. Tremendous computing power will be needed to maintain this disclosure, analysis, and reconciliation between complex algorithms and their human symbionts.

Finally, autonomous analytics will find patterns across a wealth of objective and subjective variables. Future PPA will be driven by epigenetics, trends in vitals/labs, and real-time biometrics. Laboratory data and patient reported adverse events will also be analyzed to identify combination therapies and contraindications across pharmaceuticals, botanicals, supplements, and herbs. Algorithms that test complex models (e.g., calculate the expected patient outcomes using medicine, treatment, and intervention) could be used to run virtual clinical trials. This approach will allow researchers to conduct patient- and provider-less clinical trials that put no humans at additional risk. These evidence-based CAM trials will scientifically predict the outcomes of less invasive care, behavior, and lifestyle change on patients seeking wellness or those suffering from serious conditions.

VI.4.5 *Ethical Algorithms*

The group characteristics of IM providers include a focus on ethical behavior. Participants have concerns over the potential for PPA to negatively influence medical practice. They identified ways in which presentation of data (particularly race, socioeconomic risk factors, and insurance status/payer) may bias a provider's decision making (Noble, 2018). The following functionality should reduce provider bias:

- PPA should blind factors that cause providers to treat patients unequally
- PPA should recommend CAM options with descriptions of the risk of change
- PPA should prioritize interventions by level of importance and relative risk of not starting

All CAM options should be surfaced to the provider and patient regardless of assumptions on the healthcare customer's ability to afford them. Regardless of the outputs of PPA tools, no one should be denied access to care or discriminated against in any other way. For example, if an algorithm determines a patient has a propensity for a disease, she or he shouldn't be denied insurance coverage or be employment opportunities.

Ethical algorithms allow providers to drill in and out of the data. A higher level of visibility into how PPA operates would increase trust in the system functionality and accuracy, reducing algorithm aversion. But more importantly, moving away from "black box" PPA lets providers better understand how factors were used to inform a prediction and why certain recommendations were made (Miner et al., 2014). The ability to uncover this level of granularity is considered ethical because it promotes better-informed decisions.

Finally, PPA or any other future technology may never replace the intrinsic value of physical presentation. More human intervention is needed for critical or emergent patients (e.g., mental health, depression, suicide risk, etc.). So, even if future PPA is a fit for IM MDM task characteristics, adoption won't occur if the system takes time away from busy healthcare workers and/or could introduce risk to complex patients. The value of future tools will be in their ability to enhance the patient-provider interaction and provide practice-specific information just-in-time.

VI.5 Contributions

FFTTF is a reconceptualization of the heavily published TTF theory (Goodhue, 1995). While TTF is traditionally applied to technology already in use, FFTTF provides directional understanding of whether emerging technology will meet the needs of a well-defined population of end users in the future. As FFTTF increases over time (e.g., software development delivers

better technology with more fit), it is proposed that Algorithm Aversion (negative attitudes toward adoption of PPA) will gradually decrease.

FFTFF allows researchers, technologists, and strategy consultants to perform design thinking within specific industry constructs (e.g., a company, customer type, or end user is the unit of analysis). This contribution to theory provides a new framework within which to:

- Consider the impact of innovation on a unique groups of end users
- Develop technology to fit the needs of a group of end users
- Increase emerging technology adoption rates
- Down-select technology options for the best fit to solve a group or organization's needs
- Transform healthcare and business processes with innovative technology

The FFTFF model provides insights needed to create business strategy, software development roadmaps, and innovate based on real-world needs or group characteristics.

Using PPA screenshots to identify FFTTF represents a secondary methodological contribution. This qualitative approach uses interviews to develop a high-level understanding of tasks performed. Researchers read back each high-level task (identified during the interview) to the participant and identify how the emerging technology (shown visually as screenshots, a recorded demonstration, or other visual representation) supports or does not support each task. Then, individual perceptions of the technology are identified, including proposed areas of modification, likelihood of adoption, and thoughts on future convergence with the phenomenon being investigated. This process can be easily reused by researchers hoping to understand how groups sharing a phenomenon view emerging technology (see Figure 9 in the Appendix).

This research makes a new contribution to phenomenological research methods that use interviews to identify unique group characteristics (Creswell & Poth, 2016). The following seven steps visualize relationships between the elements of a phenomenon to develop a complete story:

1. Identify textural and structural tasks (what and how) via interviews;
2. Code interviews to identify what is unique about the phenomenon (horizontalization);
3. Use phenomenological storyboarding to organize the participants' essence statements (descriptions of the nature of tasks) in a logical and temporal order;
4. Overlap related essence statements that often occur together or in an iterative fashion;
5. Identify subthemes for a group of connected essence statements;
6. State personal biases that may impact the story and methods used to reduce them; and
7. Present the composite of themes as a clear essence statement.

Theoretical saturation must occur before the researcher can safely horizontalize the qualitative data. There is a risk that the essence statement will be incomplete if phenomenological storyboarding is started too early without a strong understanding of current task and group characteristics.

The research makes contributions to the problem setting, exploration of the potential application of PPA to IM practice. The comparison of tasks to technology characteristics creates a unique offering to the literature which currently lacks qualitative descriptions of provider perspectives of emerging AI task characteristics technology. The detailed empirical description of IM MDM task characteristics makes it easier to see PPA is not currently a fit for these professionals. The rich, contextual description of "essence" provides legitimacy to IM which is gaining momentum in U.S. Socialization of IM's value may help patients and providers overcome misconceptions about IM, NM and the effectiveness of CAM modalities.

Every study participant felt PPA would eventually be applied to IM whether they supported the technology or not. IM providers' insights on PPA's overall fit are a unique contribution to the area of concern (answering the research question):

- Providers' perceptions of current PPA tools (positive, neutral, and negative)
- Healthcare scenarios best suited for PPA
- Providers' perceptions of future convergence of IM and PPA
- Comprehensive list of suggested modifications to PPA
- Factors impacting likelihood of PPA adoption
- Innovation framework to direct development of future state PPA
- Future state use cases for autonomous analytics in healthcare

Understanding new avenues for applying evidence-based medicine (e.g., predicting and measuring patient outcomes) is relevant to practitioners and Healthcare/Life Sciences technology vendors. Developing emerging technology based on research of group characteristics may lead to faster adoption rates than we have seen with other innovations like electronic data capture in clinical trials, EHR/EMR in inpatient and outpatient care, and even digital imaging.

VI.6 Limitations

Rich study results required the proper sampling of interviewees with IM licensure (e.g., doctors, nurses, etc.) and experience with chronic pain patients. This research left out massage therapists, traditional Chinese medicine (TCM) and other CAM providers who may have shifted the group characteristics. It is also possible that other supporting cast members like social workers and case workers would have identified a separate set of tasks not captured in the

results. Most importantly, the research did not include the voice of patients to identify their needs and confirm the Innovation Framework.

There were limitations to the application of phenomenological research to the medical community. Due to doctors' schedules, the process of finding time slots and confirming the virtual sessions was difficult. After the first two interviews, both sessions were combined into one longer call. This strategy increased the likelihood of completing the full set of questions for these busy professionals. However, it reduced the time available to review the list of tasks before asking the second set of questions to ascertain FFTTF.

At the time of this study, PPA for IM did not exist. All participants required education on the technology. The use of static screenshots was selected to focus interviews on a concise set of system functionality. But this process of digesting static screenshots made it more difficult for some participants to grasp PPA. Several interviewees required additional explanation, so the description of the technology was not uniform across the cohort. Others asked questions that were not central to the study; went above and beyond my knowledge of how the algorithms were designed; or could only be answered via a demonstration using a live user interface. Genericized answers to these technical questions may have reduced the robustness of participants' answers.

Finally, there may have been different results if another disease state was used as the research case. While complex and widespread, chronic pain has very many causes and a multitude of treatment protocols based on the type of treating practitioner. It is possible that another chronic disease like diabetes or hypertension would have led practitioners to show less algorithm aversion and consider PPA a better fit for treating those patient populations.

VI.7 Future Research

The success of using a phenomenological approach to explore FFTTF opens up several new areas of research. This theory can be applied to many disciplines or industries to identify areas of innovation. As the theory evolves, futurists may move past the current task-future technology paradigm to future task-future technology. These studies would be designed to explore fit between seemingly incongruent, emerging technologies and the ideal future state of IM practice to challenge the status quo of medical practice. The technology would be introduced to participants visually and they would provide a deeper dive into how adoption could totally shift future tasks characteristics (e.g., break and rebuild current processes to define areas of innovation).

There is an opportunity to further dissect phenomenological storyboarding to validate if this technique produces generalizable or reproducible results. Methodology research could include testing the best ways to codify tasks into themes and then perform horizontalization. Validated results would create methods for researchers and consultants to quickly identify the essence of groups and better understand their unique technological needs.

Within IM, there is an opportunity to better understand how providers collaborate and communicate, using a group of practitioners as a case (or several groups in a multi-case study). Qualitative research focused on the voice of the provider could identify the specific tasks, perspectives, and needs of each subgroup/medical specialty. This could identify treatment protocols across different areas of holistic medicine which would be used to design new PPA algorithms and shape the UE of receiving and managing recommendations and interventions.

Similar studies (both qualitative and quantitative) could be designed with the patient as the unit of analysis. There is an opportunity to research gamification of holistic medicine that

focuses on the impact incentivization has on provider and patient adoption of CAM modalities. This avenue would identify new ways to educate people on the benefits of holistic medicine and help them associate diet, behavior, and lifestyle changes with better health outcomes.

Within PPA, there is a need to better understand how to overcome algorithm aversion and experiment with different ways of presenting risk scores, recommendations, and interventions (e.g., alternatives to the "black box"). These studies could also focus on the role of data presentation on provider MDM and experiment with the concept of "blinding" to reduce provider bias and algorithm aversion. Technology modeling could be used to further understand how PPA will support:

- Measurement and analysis of subjective and nonverbal health factors
- Dynamic care plans with input from the extended care community
- PRO and real-time data collection from wearable devices
- Interoperability of a larger set of data sources, data security, and data privacy
- The shift to autonomous analytics (e.g., application of health outcomes to new protocols)

Finally, policy studies are needed to highlight the ethical considerations around the development of PPA. There will be a need to revisit federal and state data capture, data management, reporting, and patient privacy regulations to address the new challenges created by this field of emerging technology.

VI.8 Conclusion

This engaged scholarship used a phenomenological approach to identify the essence of how IM practitioners make decisions to improve patient outcomes. Chronic pain was selected as the case due to its prevalence in the U.S., complexity, and likelihood of being treated using IM.

Phenomenological storyboarding identified and visualized themes in IM tasks, aiding creation of an essence statement. This group of professionals described their practice as empowering for patients and unique from conventional, allopathic medicine.

Using the FFTTF theory, the research showed that PPA must go through a significant overhaul to meet current IM task characteristics and deliver the desired future state capabilities. Based on feedback from providers, PPA was fitting for emergent care where information could be missed by doctors and conditions that had well-understood and formulaic treatment protocols. Doctors benefit from technology that aggregates and exposes historical information, providing a clear patient snapshot. However, PPA was designed for allopathic systems that treat sickness versus tracking patients toward wellness, so it had low fit for IM decision making.

In the ideal future, PPA will be designed with a better understanding of the IM task and group characteristics. It should be designed to take a patient-centric approach and support the unique way providers practice medicine. PPA must not introduce administrative and transcription burden and should instead put time back in the hands of busy professionals, enhancing the patient-provider experience. Individualized care and holistic medicine focused on the mind, body, and spirit will require technology that captures and surfaces information from a complex data ecosystem, allows for communication and collaboration across the community of care, and considers the many objective and subjective factors contributing to the path to wellness.

VII APPENDICES

Appendix A: Research Design Summary (adapted from Mathiassen, 2017)

RESEARCH COMPONENT	DETAILS
Title	**Phenomenological assessment of Integrative Medicine decision-making and the utility of Predictive and Prescriptive Analytics tools**
Area of Concern	▪ Exploration of the essence of integrative medicine (IM) to understand if predictive and prescriptive analytics (PPA) may or may not be a fit for this type of medical practice
Problem Setting	▪ More U.S. patients are seeking integrative medicine to complement or as an alternative to allopathic or "Western" medicine ▪ PPA technology is currently used in U.S. hospitals to predict/measure patient outcomes and recommend treatment, interventions, medications, etc. ▪ PPA technology is not currently designed for IM or the primary care setting ▪ There is a lack of qualitative research describing provider perspectives on application of emerging technology (AI/ML/PPA) on decision-making
Conceptual Framing	▪ FA: Task-Technology Fit (TTF) (Goodhue and Thompson, 1995) ▪ Understand the tasks characteristics (activities the user must perform) and technology characteristics (capabilities of the future state PPA tool). ▪ Expectation that subset of study participants will demonstrate algorithm aversion, an unwillingness to defer their expertise/intuition to the recommendations of artificial intelligence (PPA). This is exacerbated when providers can't intervene with the technology or modify the results.
Method	▪ Qualitative, interpretivist research that uses a Phenomenological approach (Creswell, 2013) to distill the common "essence" of IM practitioners, identifying the WHAT and the HOW of the patient-physician relationship. ▪ Performed semi-structured interviews virtually. The first half identified IM tasks. In the second half, participants were shown screenshots of a PPA tool used in U.S. hospitals to understand providers' perception of the technology and TTF (at a conceptual level). ▪ Used phenomenological storyboarding to identify essence of IM medical decision-making
Research Question	▪ How can predictive and prescriptive analytics tools (PPA) support/innovate integrative medicine decision-making processes and improve outcomes for patient populations suffering from chronic pain?
Contributions	C_P ▪ Detailed empirical description of the "essence" of integrative medicine decision-making and how PPA may or may not be a fit for these professionals C_A

	▪ Insights on the task characteristics of integrative medicine ▪ Providers' perceptions of current PPA tools (positive, neutral, and negative) ▪ Healthcare scenarios best suited for PPA ▪ Providers' perceptions of future convergence of IM and PPA ▪ Comprehensive list of proposed modifications to PPA ▪ Factors impacting likelihood of PPA adoption ▪ Innovation framework to direct development of future state PPA ▪ Future state use cases for autonomous analytics in healthcare C_T ▪ Future-Focused Task-Technology Fit model to predict fit of emerging technology to current task performed by unique individuals/groups ▪ Theoretical link between FFTTF and Algorithm Aversion C_M ▪ Sharing visualization of technology screenshots with medical professionals to gain perceptions of an emerging technology ▪ Phenomenological storyboarding process to identify essence

Appendix B: Analysis of Study Validity

Study #	Research Approach	Empirical Basis	Analysis Method	Overall Validity
1 – Angehrn et al., 2020	▪ Literature Review ▪ Qualitative	▪ 4 cases identified to represent a spectrum of clinical situations	▪ Analysis of PubMed and grey literature (identified on the websites of regulatory agencies)	▪ Conclusion drawn from thorough lit review
2 - Ching et al., 2018	▪ Literature Review ▪ Qualitative	▪ Referenced works consisted of 372 DOIs, six PubMed Central records, 129 arXiv manuscripts and 48 URLs (webpages as well as manuscripts lacking standardized identifiers).	▪ Continuous analysis to track updates to source literature	▪ Conclusion drawn from thorough lit review
3 – Chin-Yee & Upshur, 2019	▪ Theoretical Paper ▪ Qualitative	▪ Epistemological-ontological, epistemological-logical, and	▪ Theoretical Inference	▪ Conclusions drawn from 3 theories

		phenomenological assessment		
4 - Geng et al., 2020	▪ AI/ML Modeling ▪ Quantitative	▪ 14,075 medical records of clinical from EMRs, and an external test data set consisting of 1000 medical records	▪ Performance estimation of an algorithm applied to real and test data	▪ Strong accuracy measurement (0.9586 in the test data set)
5 – Prosperi et al., 2018	▪ Theoretical Paper ▪ Qualitative	▪ List of technical and societal hurdles identified	▪ Theoretical Inference	▪ Perspective piece (potentially not repeatable)
6 - Young & Kemper, 2013	▪ Abstraction of doctor intake forms ▪ Quantitative	▪ 2 years of data from academic pediatric clinic, 110 new pediatric patients	▪ Numerical Analysis of patient data	▪ Conclusion drawn from data

Appendix C: Key Findings from Literature Review

	FINDING 1	FINDING 2	FINDING 3	TRANSLATION
Study 1	"The increasing availability of healthcare data and rapid development of big data analytic methods has opened new avenues for use of AI and ML based technology in medical practice"	"While tested and validated algorithms for precision dosing exist, their implementation at the point of care is limited, and their regulatory and commercialization pathway is not clear. "	"The number of promising AI/ML-based technologies is increasing, but few have been implemented widely at the point of care"	**Further research is needed on external validation, implementation logistics, and data exchange and privacy**
Study 2	"We find that deep learning has yet to revolutionize biomedicine or definitively resolve any of the most pressing challenges in the field, but	"For a given patient, the number of possible diseases is very large, with a long tail of rare diseases and patients are highly	"It is by no means inevitable that deep learning will revolutionize these domains, but given how	**Unique applications of AI exist and are well described in the research. However, application of AI to multiple**

	promising advances have been made on the prior state of the art."	heterogeneous and may present with very different signs and symptoms for the same disease"	rapidly the field is evolving, we are confident that its full potential in biomedicine has not been explored."	**physiological systems is complex and not well understood**
Study 3	"We are still some ways from developing AI that reproduces human reasoning and practical knowledge, of which clinical judgment is a paradigmatic example"	"Claims that physicians will soon be replaced by AI are indeed overstated"	"The growth of big data and machine learning may have more immediate consequences in clinical medicine"	**Adoption of AI will be gradual and phenomenological research is needed to avoid incorrect application**
Study 4	"Integrative medicine…combines practices and treatments from alternative medicine with conventional medicine. Diagnosis…involves the clinical diagnosis based on modern medicine and pattern diagnosis."	"Application of artificial intelligence techniques to support physicians in medical practices remains a major challenge."	The algorithm "showed high performance in the syndrome pattern diagnosis of lung diseases in integrative medicine"	**Within a well understood patient population, the algorithms are very accurate**
Study 5	"Technological advancements permit the collection and merging of large heterogeneous datasets from different sources"	"Many barriers still exist against achieving precision medicine and precision public health interventions for the benefit of the individual and the population."	"Data science for precision medicine and public health warrants an informatics-oriented formalization of the study design and interoperability"	**Use of socio-economic, gender, and race characteristics may create bias and/or misuse of AI tools**

Study 6	Chronic pain patients present with complex list of symptoms and are willing to try multiple modalities	"Patients who have chronic pain and who present to an integrative clinic frequently have complex conditions and care. They are interested in promoting a healthy lifestyle, reducing stress, and using selected complementary therapies."	"Patients with chronic pain who seek integrative care may benefit from the kind of coordinated, integrated, comprehensive care provided in a medical home."	**IM has value for complex patients who need an alternative to allopathic medicine**
Translation	**Exploratory research is needed, not enough is known about how emerging tech will be applied to healthcare**	**Complexity of disease states makes it very difficult to predict with accuracy or recommend a comprehensive list of potential treatments, modalities, & medicines**	**Patients benefit from IM; benefits are expected but are not well researched for the application of tech**	**There is room for exploration. Research on the use of PPA to innovate IM has value!**

Appendix D: Medical Practice, Description and Modalities

MEDICAL PRACTICE	DESCRIPTION	MODALITIES
Allopathic Medicine	"Western" medicine, disease-based, prescribe drugs, seek a specialist, deductive, not holistic	Primary Care, Specialty Care, Surgery, Pharmacy
Complementary and Alternative Medicine (CAM)	Complimentary when used in addition to Allopathic; Alternative when used instead of Allopathic; CAM, intuitive may be applied holistically	Behavioral changes, Massage therapy, sound, herbalism, aromatherapy, yoga, chiropractic, acupuncture, massage therapy, dietary supplements, homeopathic and naturopathic medicine
Naturopathic Medicine	Ethnic and "traditional" healing, natural, wellness-based, many global flavors, holistic	Clinical nutrition, smoking cessation, herbalism, colon therapy, Ayurvedic medicine
Integrative Medicine	Focus on patient-physician relationship, health and wellness, behaviors, holistic care plan	Primary Care, Specialty Care, Surgery, Pharmacy, CAM & Naturopathic modalities

Note. This is not an exhaustive list. These categorizations propose the differences between medical practice based on the level of holistic approach and philosophical views on the nature of health/wellness and root cause of disease/unwellness.

Appendix E: ICD-11 Designation for Primary and Secondary Chronic Pain

Chronic primary pain is characterized by disability or emotional distress and not better accounted for by another diagnosis of chronic pain. Here, you will find chronic widespread pain, chronic musculoskeletal pain previously termed “non-specific” as well as the primary headaches and conditions such as chronic pelvic pain and irritable bowel syndrome. They are recognized as a group of chronic pain syndromes for the first time in ICD-11. Chronic secondary pain is organized into the following six categories:

1. Chronic cancer-related pain is chronic pain that is due to cancer or its treatment, such as chemotherapy. It will be represented in the ICD for the first time.

2. Chronic postsurgical or post-traumatic pain is chronic pain that develops or increases in intensity after a tissue trauma (surgical or accidental) and persists beyond three months. It is also part of the ICD for the first time.

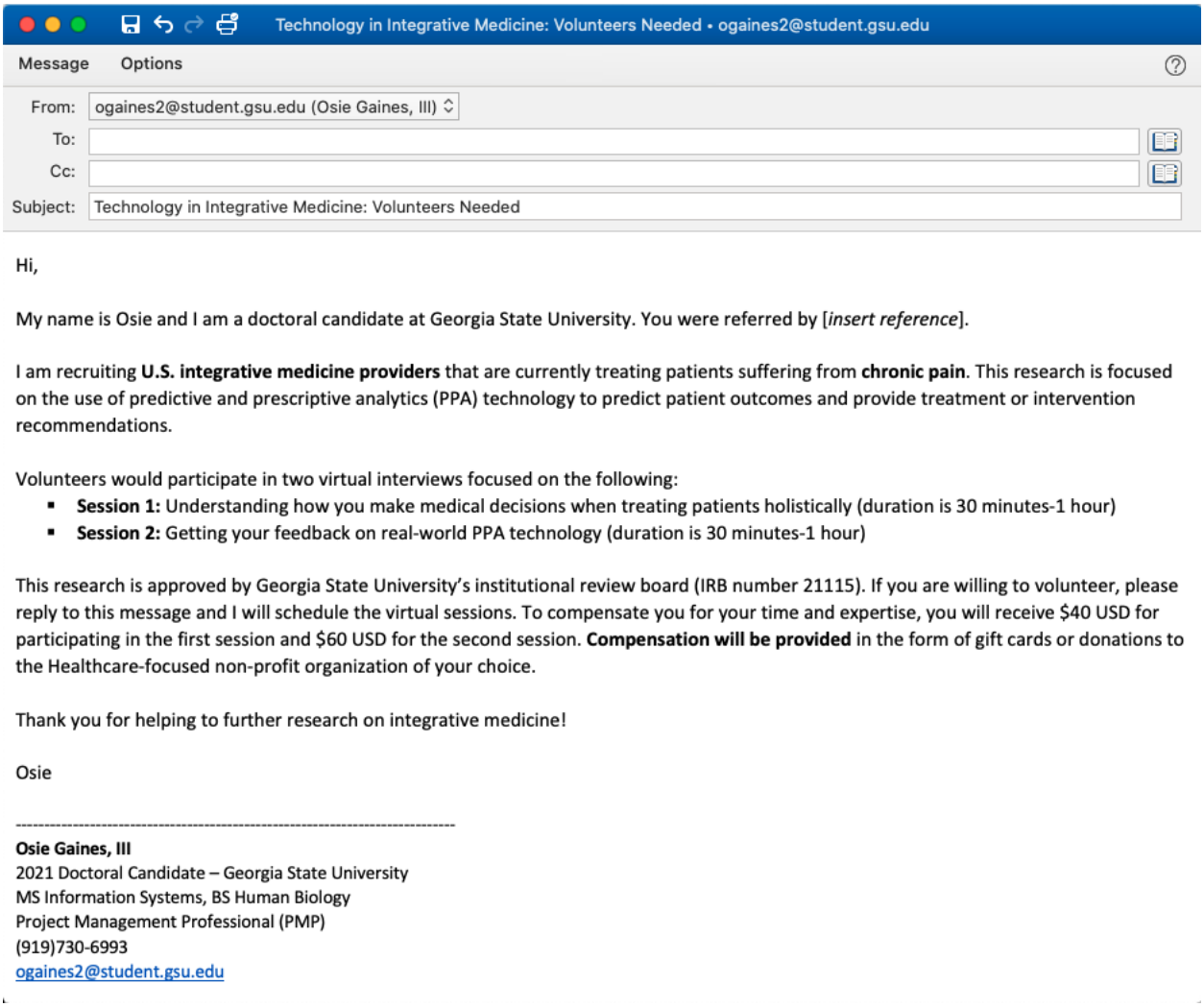
3. Chronic neuropathic pain is chronic pain caused by a lesion or disease of the somatosensory nervous system. Peripheral and central neuropathic pain are classified here. These diagnoses are also newly represented in the ICD.

4. Chronic secondary headache or orofacial pain contains the chronic forms of symptomatic headaches (those termed primary headaches in the ICHD-3 are part of chronic primary pain) and follows closely the ICHD-3 classification. Chronic secondary orofacial pain, such as chronic dental pain, supplements this section.

5. Chronic secondary visceral pain is chronic pain secondary to an underlying condition originating from internal organs of the head or neck region or of the thoracic, abdominal, or pelvic regions. It can be caused by persistent inflammation, vascular mechanisms or mechanical factors.

6. Chronic secondary musculoskeletal pain is chronic pain in bones, joint and tendons arising from an underlying disease classified elsewhere. It can be due to persistent inflammation, associated with structural changes or caused by altered biomechanical function due to diseases of the nervous system. (Barke, January 17, 2019)

Appendix F: Recruitment E-mail Template



Technology in Integrative Medicine: Volunteers Needed • ogaines2@student.gsu.edu

Message Options

From: ogaines2@student.gsu.edu (Osie Gaines, III)

To:

Cc:

Subject: Technology in Integrative Medicine: Volunteers Needed

Hi,

My name is Osie and I am a doctoral candidate at Georgia State University. You were referred by [*insert reference*].

I am recruiting **U.S. integrative medicine providers** that are currently treating patients suffering from **chronic pain**. This research is focused on the use of predictive and prescriptive analytics (PPA) technology to predict patient outcomes and provide treatment or intervention recommendations.

Volunteers would participate in two virtual interviews focused on the following:

- **Session 1:** Understanding how you make medical decisions when treating patients holistically (duration is 30 minutes-1 hour)
- **Session 2:** Getting your feedback on real-world PPA technology (duration is 30 minutes-1 hour)

This research is approved by Georgia State University's institutional review board (IRB number 21115). If you are willing to volunteer, please reply to this message and I will schedule the virtual sessions. To compensate you for your time and expertise, you will receive $40 USD for participating in the first session and $60 USD for the second session. **Compensation will be provided** in the form of gift cards or donations to the Healthcare-focused non-profit organization of your choice.

Thank you for helping to further research on integrative medicine!

Osie

Osie Gaines, III
2021 Doctoral Candidate – Georgia State University
MS Information Systems, BS Human Biology
Project Management Professional (PMP)
(919)730-6993
ogaines2@student.gsu.edu

Appendix G: Informed Consent Form

Title: Phenomenological assessment of Integrative Medicine Decision-Making and the Utility of Predictive and Prescriptive Analytics Tools

Principal Investigator: Dr. Carol Saunders
Co-Investigator: Dr. Lars Mathiassen
Student Principal Investigator: Osie Gaines, III

Procedures

You are being asked to take part in a research study. This research is focused on the use of predictive and prescriptive analytics (PPA) technology to predict patient outcomes and provide recommendations for treatments or interventions. The research team is interviewing U.S. integrative medicine providers that are currently treating patients suffering from chronic pain.

If you decide to take part, you will be asked to participate in two virtual interviews focused on the following:

- Session 1: Understanding the medical decision-making process when treating patients holistically
    - You will answer questions about your process with chronic pain patients
    - Estimated duration is 30 minutes-1 hour
- Session 2: Getting your feedback on PPA technology (duration is 30 minutes-1 hour)
    - You will view screenshots from PPA technology currently used in hospitals
    - You will answer questions about how PPA may or may not fit your ways of working
    - Estimated duration is 30 minutes-1 hour

If it is more convenient for you, both interviews can be combined into one session (estimated to last 1-2 hours). Based on your response, the research team will schedule the interview(s) and send WebEx virtual meeting invitations to your e-mail address.

The interviewer will be located in Atlanta, GA (Eastern time zone). Your interview responses will be recorded via the WebEx software and using a separate audio recorder. These files will be maintained in a secure location. No one outside of the research team will have access to these audio files. Information that can identify you individually will not be released to anyone outside the study. Once the research is finalized, these recordings will be permanently deleted.

Compensation

You will receive the following compensation for participating in this study:

- $40 USD for participating in the first session; and
- $60 USD for participating in the second session

Compensation will be provided in the form of gift cards or donations to the Healthcare-focused non-profit organization of your choice. Compensation will be paid within one week of interview completion.

Voluntary Participation and Withdrawal

The Georgia State University Institutional Review Board has reviewed my request to conduct this project (IRB number 21115). Your participation in this study is voluntary. You do not have to be in this study. You may skip questions during the course of the interview or stop participating at any time. For example, if you are only able to complete the first interview, you will not be coerced to complete the second interview.

Contact Information

Carol Saunders: csaunders@gsu.edu
Osie Gaines: ogaines2@student.gsu.edu

Consent

If you are willing to volunteer for this research, please give your verbal consent to the researcher.

Appendix H: Semi-Structured Interview Script

	MAJOR TOPICS	RELATED INTERVIEW QUESTIONS
Interview Part 1	**Background**	1. Please state your name, current role, licensure, and years of professional experience. 2. Is your medical license recognized by the state in which you practice? What's the impact on your patients? 3. How and where were you trained in medicine? 4. At a high level, please describe your methods when treating a patient with chronic pain. 5. At a high level, please describe how you would identify the risk level for patients. 6. What are some difficulties/areas of complexity for treating/managing a patient with chronic pain?
	Integrative Medicine Decision-Making (MDM)	Integrative medicine focuses on health and healing and emphasizes **the centrality of the patient-physician relationship**. In addition to providing the best conventional care, integrative medicine focuses on preventive maintenance of health, wellness, behaviors, and a holistic care plan. 1. How would you describe the integrative MDM process? 2. What is unique about integrative medicine that leads to successful patient outcomes? 3. How do you apply a holistic approach to a patient with chronic pain? 4. Can you share an example when your intuition/expertise made you reject the standard of care or prescribe something other than the gold standard medicine for a patient? 5. Please describe the tools/technology you currently use to measure/predict chronic pain patient outcomes. 6. Please describe the tools/technology you currently use to get recommendations for chronic pain patients.
Interview Part 2	**Predictive & Prescriptive Analytics (PPA)**	▪ Show the participant screenshots of an AI tool that uses PPA to aid medical decision making ▪ Show examples of a chronic pain patient ▪ Describe the data source used by the PPA, the algorithm used, and the outputs 1. What is the extent of your experience with PPA tools? 2. What do you like most/least about this tool (overall perception, user experience, presentation of information)? 3. How could these systems be modified to better serve you? What additional inputs/outputs are needed?

		4. What would cause you to doubt the outputs of these types of systems when treating patients holistically? 5. Can you share a scenario in which your intuition/expertise would make you reject the outputs of PPA? 6. Which patient types/MDM scenarios are best supported by these types of tools? Which are least suited? Why?
	Ideal Future State	**Revisit the elements of the predictive analytics tool and shift to future state questions:** 1. Should there be a convergence between PPA and integrative medicine? Why or why not? 2. Which types of decisions could be supported by PPA? Which decisions are inappropriate for PPA? 3. What is the potential for PPA tools to replace parts of your MDM process? Why or why not? 4. How will technology be used to predict and measure patient outcomes and provide recommendations in 10 years? 5. Is there anything else I haven't asked about your MDM process that I should ask?

Appendix I: Coding Schema

CODE/SUBCODES	DEFINITION
Provider Background Medical Licensure Training Professional Experience PPA Tool Experience Other Technology in Use	▪ Descriptive statistics ▪ Provider's description of their current role and medical licensure (including if it was recognized by the state of practice) ▪ Details about how they were trained in medical schools, institutions, and other ways ▪ Years of experience working with patients ▪ Experience using predicative and/or prescriptive tools ▪ Additional technology/tools used to manage work, predict patient risk/outcome, and/or recommend actions
Patient Stories	▪ Includes stories of an anonymized patient's symptoms, their personal journey, and outcomes. ▪ It also includes any descriptions of patient's perspective of the provider relationship and care received.
Impactful Quotes Essence of IM	▪ Quotes in which the provider described a process or topic passionately and with sincerity. ▪ It also includes descriptions of the essence of IM and/or nuance in the way they work with patients.
Task Characteristics: Textural Perform Intake/ Assessment Make/ Update Diagnosis Create/Manage Treatment Plan Engage Care Community Perform Administration Manage Ongoing Education Other	▪ High-level code-WHAT providers do ▪ Steps taken to collect historical and real-time patient data ▪ Steps taken to confirm, reassess, and update the patient diagnosis ▪ Steps taken to create, reassess, and update the treatment plan and/or pain contract ▪ Steps taken to refer a patient to another provider, communicate and collaborate with the community of care ▪ Steps taken to perform insurance payer, state regulation, and other types of legal/financial/managerial administration ▪ Steps taken to educate the patient or provider on allopathic and CAM modalities ▪ Any additional tasks
Task Characteristics: Structural Holistically Gradually Using Objective & Subjective Data Within Care Community	▪ High-level code-HOW providers perform tasks (contextual) ▪ Descriptions of mind, body, spirit approach ▪ Descriptions of stepwise approach ▪ Descriptions of diverse data types

While Empowering Patients	▪ Descriptions of how the care community communicates and collaborates ▪ Descriptions of patient-focused approach
Technology Characteristics Screenshot 1 (Positive, Neutral, Negative) Screenshot 2 (Positive, Neutral, Negative) Screenshot 3 (Positive, Neutral, Negative	▪ High-level code ▪ Includes modifications, additional inputs/outputs
TTF, Ideal Future State Convergence (Positive, Neutral, Negative) Scenarios Best Supported by PPA PPA Modifications, Additional Inputs/Outputs	▪ High-level code ▪ Values/Attitudes/Beliefs on future convergence of IM and PPA ▪ Description of the patient types, care scenarios best supported by PPA ▪ Descriptions of proposed changes to make PPA a better fit for IM

Appendix J: Additional Evidence from Qualitative Interviews

Table J1: High-level Tasks Identified during IM Portion of Interviews

INTEGRATIVE MEDICINE TASKS
▪ Take a gradual approach
▪ Manage ecosystem of providers
▪ Communicate options with patients
▪ Treat Holistically (Mind, Body, Spirit)
▪ Take patient history
▪ Perform physiological, neurological, & chiropractic assessment
▪ Order and analyze imaging/x-rays
▪ Track compliance with treatment plan
▪ Provide immediate feedback to patients
▪ Track stepwise recommendations and results
▪ Record results of 1 to 3-hour assessment
▪ Assess patient across 3 angles
▪ Manage referral process
▪ Collaborate with other providers
▪ Track provider's unique spreadsheet of key factors
▪ Track parasympathetic factors
▪ View ultrasound results
▪ Track details for complex patient
▪ View past medical history
▪ View patient's story over time
▪ Track lifestyle modification
▪ Reassess original diagnosis (including from another provider)
▪ Analyze comorbidities
▪ Identify "center of gravity" (objective and subjective goals)
▪ Support multi-organ approach
▪ Order a food panel and analyze results
▪ Track small steps over time
▪ Record feedback – SOAP Notes
▪ Collaborate with rheumatologist
▪ View advanced imaging
▪ Conduct Functional Screening
▪ Review Orthopedic Test Results
▪ Record results of 1-hour first visit, history, previous surgeries
▪ Communicate with functional medicine or naturopathic doctor
▪ Record patient reported pain scale
▪ Monitor daily habits
▪ Review patient prescription history
▪ Follow state guidelines for controlled substance management
▪ Track patient trust level
▪ Record treatment plan and pain contract

- **Track changes to the comprehensive treatment plan**
- **Manage referrals and flag bad providers**
- **Collect patient history**
- **Record results of the clinical evaluation and physical exam**
- **Follow risk models based on specialist protocols**
- **Refer to other providers**
- **Track changes to behaviors and lifestyle**
- **Record detailed history**
- **Track lifestyle over time**
- **Record psychosocial functions**
- **Record notes about impact of antipsychotic meds**
- **Educate patients about holistic options**
- **View lab results**
- **Identify CAM modality options**
- **Help patients associate changes to QOL (gamification)**
- **Share homework/research topics with patients**
- **Identify barriers to compliance**
- **Identify psychosocial factors impacting health**
- **Communicate with mental health networks**
- **Interview patient to agree upon a care plan**
- **Request and view previous records**
- **Manage disability application paperwork and process**
- **Interact with state Medicare system for opioid misuse**
- **Refer to pain specialists, case managers, social workers**
- **Receive education on additional modalities, articles, guidelines**
- **Record subjective pain measures**
- **Align on a care plan**
- **Order additional labs and view results**
- **Document psychiatric medication treatment plan**
- **Perform acute crisis stabilization (disposition planning)**
- **Use talk therapy to track patient to resolution**
- **Track lifestyle modifications**
- **Conduct safety assessments to identify red flags**
- **Perform screening questionnaires and record diagnosis**
- **Request bloodwork and record results**
- **Track concomitant medication data and physical symptoms**
- **Collect detailed medical history**
- **Manage treatment options**
- **Collect controlled substance history**
- **Record matrix of CAM modalities and outcomes over time**
- **Mange pain medication contract and morphine dose equivalence**
- **Keep tracking of lifestyle and diet management at the forefront**
- **Monitor bloodwork and metabolic deficiency**
- **Record subjective pain scale measure**
- **Manage referrals to other providers**
- **Take medical history**

- **Perform physical exam**
- **Collect vital signs and biometrics**
- **Involve social workers**
- **Refer to specialists**
- **Track behaviors and lifestyle**
- **Track diet and gut rest (intermittent fasting)**
- **Perform genetic testing**
- **Perform ultrasound**
- **Perform lab work**
- **Research new scientific knowledge**
- **Review patient questionnaire/Interview for history**
- **Review X-rays/images**
- **Identify barriers to accessing care**
- **Introduce many modalities**
- **Manage diet, lifestyle, and water intake**
- **Research IM websites and attend conferences**

Table J2: Task Characteristics Coded from Interviews

TASK CHARACTERSTICS
Accept patient input on meds they want to take
Accept that another provider may correctly disagree with your assessment
Accept the value & frequency of second opinions
Actively listen as core of mental health practice
Actively manage meds with goal to titrate down over time
Add physical therapy when patient is ready
Address diet and nutrient levels
Address Factors leading to Dysfunction
Address Hydration Without Punitive Approach
Address Mental Health
Address mental health first
Address sleep to reduce anxiety
Address Spiritual Health
Admit to psych facility if patient poses threat to themselves or others
Allow patients to choose provider who support other ways of practicing
Allow several visits to build trust
Apply Chinese Medicine Perspectives
Apply Cognitive Behavioral Therapy
Apply Gradual Recommendations Across Frequent Visits
Apply Spirituality Gradually for Non-Religious Patients
Approach Chronic Pain from 3 Angles
Ask additional questions to identify barriers to care
Ask additional questions to supplement the care community
Ask critical questions to complete patient safety assessment
Ask myriad of questions to perform root cause analysis
Ask patient's comfort level with options
Ask questions to identify stress, lifestyle, diet
Ask questions to take holistic approach
Ask questions to understand what modalities patients will consider
Assess and Treat from **all Angles**
Assess health using 7 biophysical nodes
Assess History to Understand Patient Complexity
Assess Hydration
Assess Impact of Geography to Care
Assess Impact of Lifestyle
Assess Mobility
Assess Need for Imaging
Assess Neuropathy
Assess Patient's Spirituality with **Non-Threatening Questions**
Assess the Individual Pathophysiology and Disease Progression to Assess Risk
Assess Original Diagnosis to Confirm Risk
Avoid a cookie cutter approach

Avoid compartmentalizing patient problems
Avoid giving pain meds
Avoid information overload, revisit some patient education later
Avoid Making Patient Assumptions Based on Risk Level
Avoid prescribing meds that increase other risk levels like obesity
Avoid Setting Incorrect Expectations with Risk Assessment
Avoid undermining another provider who may be incorrect
Avoid use of narcotics with pregnant patients
Avoid white coat attitude to establish comfort
Be passionate about improving patient outcomes
Be realistic about drug abuse and family issues
Beware System Bias That Minimizes Individualization of Care
Bring in other professionals based on comfort level
Build Patient Confidence Through Gradual Wins
Change Lifestyle to Reduce Pain
Collaborate with Patient and Other Providers
Collaborate with patient to create treatment plan
Combine Herbal Meds & Therapy for Mental Health Outcomes
Combine modalities that are not standard of care
Communicate Tough Choices with other Providers
Communicate with Providers
Compare objective and subjective goals
Compare patient history with physical exam
Conduct 30-minute initial assessments
Conduct a follow-up call to track outcomes
Conduct Orthopedic Tests
Conduct Physical Exam
Confirm patient's controlled **substance use**
Confirm prescription use and behavior
Confirm prescriptions in state MAP system
Consider all patients as individuals
Consider behaviors before surgery
Consider conservative measures first
Consider Contributing Factors That May Supersede Risk Level
Consider many modalities for unique patients
Consider Multiple Modalities
Consider multiple sources of pain
Consider opioid abuse and addiction
Consider Other Providers' Perspectives
Consider Patient Feedback
Consider Patient Psychology if Sharing Predictions
Consider Perspective of Treating Physician & Patient
Consider sleep and nutrition after initial assessment
Consider Surgery as cause of additional pain
Consider the patient as a partner

Consider the patient's subjective pain scale scores
Continue education based on patient types you typically manage
Cooperation with Labs, Providers Reduces Insurance Issues
Coordinate patient's search for specialists with limited availability
Correct diagnosis allowed provider to remove unneeded meds
Create Community of Care
Create relaxing environment for the patient
Create Team of Providers to Beat Cancer
Detach to Provide Professionalism
Discuss approach with the patient
Discuss Biomechanical Problems Causing Pain
Discuss Goals for Increasing QOL
Discuss results of assessment & physical exam with patient
Discuss role of therapy with patients
Do not blindly accept CAM, be evidence-based
Do not shoot down recommendations, consider them
Do not use meds just to mask symptoms
Don't give up-continue to suggest necessary treatment
Earn the patients' trust
Educate patient about benefit of laugh therapy
Educate patient about medical hypnosis
Educate Patient on Cause of the Issue
Educate patient on impact of gut rest
Educate patient on the new diagnosis
Educate Patients on How Care Will Be Provided
Educate Patients on Other Providers' Recommendations
Educate Patients to Make Better Decisions
Elicit detailed patient history
Embrace awkward conversations with providers who disagree with treatment plan
Embrace holistic approach as a Nurse
Encourage Patients to Take on Right-Sized Spiritual Exercises
Establish patient's ability to manage pain management contract
Exercise patience with over-anxious patients
Explain MDM Approach with Patient
Explain Risks of Stopping Recommended Treatment
Expose your humanity & fragility to connect
Find financially realistic plan
Focus on acute crisis stabilization
Focus on health promotion and disease prevention
Follow a Framework
Follow state of MI guidelines
Help patient assign lifestyle changes to good outcomes
Honestly explain subset of issues that you can solve
Identify additional stressors causing patient anxiety

Identify and manage substance abuse issues
Identify Comorbidities to Assess Risk
Identify conditions that may not be resolved during pregnancy
Identify Contraindications
Identify cultural, belief, and age factors impacting pain
Identify Daily Habits that Impact Pain
Identify economic barriers to care access
Identify environmental factors contributing to illness
Identify if drug abuse or misuse occurred
Identify lifestyle changes for patients seeking to get pregnant
Identify lifestyle modifications, meds, and therapy plan
Identify lifestyle, daily habits, occupation, environment
Identify Low Hanging Fruit Lifestyle Changes
Identify medical complexities and refer patient to specialists
Identify mental health factors impacting overall health
Identify mental impact of chronic pain
Identify Past Pain, Surgery, Injuries
Identify patient diet, hydration, anxiety
Identify patient needs and build care community
Identify Risk in Special Populations
Identify Risk Level
Identify risk level of patient presenting with mental health issues
Identify risk of substance abuse for pain patients
Identify Short- and Long-Term Goals
Identify the severity of mental illness
Identify treatment options other than just giving drugs
Identify trends to understand which additional labs to order
Identify what cure means for the patient
Identify when guidelines are not working and update plan
Include family in education & decision process
Incorporate additional modalities even if working in allopathic practice
Identify and Heal the Underlying Cause
Identify financial and insurance barriers to care access
Individualize Care
Introduce gradual changes led to improve mobility
Introduce Spiritual options Gradually and Respectful of Differences
Invest 1 hour in intake meeting
Invest Time to Build Provider-Patient Trust
Invest time to understand day in the life of the patient
Keep Patient on Drug for QOL While Considering Other Options
Keep the patient calm
Lean on Expertise and Consider Alternative Options to Identify Recommendations
Learn from pain experts
Listen to the patient

Listen to the patient story
Listen to your inner voice
Log in, get **recommendations from National Surgical Quality Improvement Program**
Maintain dynamic treatment plan
Maintain eye contact with patients
Maintain fine balance when prescribing pain meds
Maintain list of providers for referral
Make decision to reduce controlled substances
Manage acute mental health issues aggressively
Manage Care Plan with Team of Providers
Manage depression presenting with pain
Manage Diet
Manage Lifestyle
Manage Mental Health to Improve Compliance with Other Treatments
Modulate Frequency of Care
Offer Second Opinion
Optimize patient's sleep so they can heal
Order additional labs and ask more questions for root cause analysis
Overcome Patient Negativity
Paint a Vision to Inspire Patient Lifestyle Change
Perform 1-3 Hour Initial Consultation
Perform Acupuncture
Perform active listening to form alliance with patients
Perform Active Release Therapy
Perform Functional Assessments of Risk, Outcomes
Perform Holistic Assessment
Perform Intake, Health History
Perform Lab Tests
Perform Neurokinetic Therapy
Perform ortho Tests to recreate pain issue
Perform root cause analysis first and then treat patient
Perform root cause analysis to understand the deeper cause of pain
Perform Root Cause Analysis
Perform Ultrasound and Guided Needle Treatments
Positively Impact QOL at a Minimum
Practice individualized care
Prescribe Alternatives Not Just Herbal Equivalent of a Pharmaceutical
Prescribe herbal remedy instead of SSRI med
Prescribe Hormone Balancing Supplements
Prescribe Supplements
Prescribe Supplements, Botanicals, Topical Meds
Prioritize Patient Issues and Identify Interdependencies
Promote a Healthy Nervous System
Promote journaling so patients can weigh in on the care plan

Provide all options & the best option
Provide chart notes to help others understand decisions made
Provide Education Sincerely to Change Patient's Mind
Provide Holistic Care
Pull Out Intake Data Patients Hide
Reach out to patients to show you care
Realize that some patients want pills not holistic medicine
Recognize Sports Medicine is Individualized
Recommend Based on Lifestyle
Recommend Gradual Change
Recommend Lifestyle Changes and Acupuncture
Recommend supplements, herbal remedies, calming teas
Reconsider the results of labs & reference ranges
Reconsider Treatment
Reduce Confusion of Medical Jargon
Reduce Patient Costs by **Referring to Providers Who take Insurance**
Refer chronic pain patients to pain management specialist for meds
Refer Complex patient to Functional Doc
Refer for Surgery to Stabilize Biomechanics
Refer Patient for Management of Psych
Refer Patient Out if Chiro Doesn't Work
Refer to a pain specialist
Refer to chiro with expectations about care
Refer to primary care for bloodwork
Refer to specialists who can focus on pain and medication
Refer to surgeon for evaluation and education
Reject Previous Diagnosis After Explaining Why to Patient
Reject Standard of Care
Remain a stickler to standards of care
Remain Flexible to Patients' Chiro Adoption Rate
Remain Flexible to Patients' Resources
Remain fluid to consider other options
Remain open to being incorrect
Remove Restrictive Diet Providing No Improvement
Request more frequent visits for complex patients
Request past disability paperwork to understand history
Require patients to fill out a questionnaire
Reset patient goals with expectation pain may still occur
Respect Fact That Chiro May Not Work
Respect opinion of other specialists
Respect Other Providers' Opinions
Respect patient use of chiro even if not a fan of it
Respect patient's experience & opinion on med that works for them
Review MRI results and update plan
Review practice parameters to stay up to date

Run Food Allergy Panel to Assess Root Cause
Run Labs and Hormone Panels as Predictive Tools
Run Multiple Tests to Identify Causes & Root Cause of Pain
Schedule 30-min clinical appointments for new patients
Seek to trust the patient
Series of Tests & Follow-up Reduced Gastro Symptoms
Set Realistic Expectations for Lifestyle Change
Set Realistic Expectations with Patients
Show real concern for patients
Show Sympathy Even When Disagreeing with **Patient Choice**
Show understanding to overcome patient resistance
Spend 30min to 1hour to assess patients
Stabilize tough patient and then continue root cause analysis
Stay up to date on changing guidelines
Step back and consider back-up plans
Supplement intake with bloodwork to predict outcomes
Take history in initial visit
Take Humble Approach to Empower Patient to Make Gradual Progress
Take Less Invasive Approach
Take Multi-Organ Approach & Address Contributing Factors
Take time to listen to the patient
Talk to colleagues for recommendations
Teach breathing techniques to reduce anxiety
Teach Holistic Approach Patiently to Analytical Patients
Teach Patient Several Meditative Practices
Track patient outcomes after they are referred to pain specialist
Track subjective pain score over time
Treat the entire person
Triage serious issues to ER
Try to limit use of opioids
Understand dynamic list of controlled substances
Understand Impact of Pain of Ability to Function
Understand limitation of appointment time
Understand Mechanistic Perspective
Understand other providers may be needed
Understand patients may not have access to healing foods
Understand that patients may not be used to having a voice in their care
Understand that your diagnosis may be wrong
Understand the Patient's Individual Milieu
Understand the Patient's Individual Situation
Understand unique patients will score pain differently
Understand which conventional, IM, CAM modalities a patient has used
Use basic principles to identify risk
Use biomechanical fixes before suggesting advanced imaging
Use biometrics, vital signs & lab work to predict patient risk

Use Center of Gravity Technique for Root Cause Analysis
Use Conferences and Consultation to get Recommendations
Use conferences to learn new modalities and medications
Use detailed history to understand how pain impacts lifestyle
Use Epidemiology to Assess Risk
Use evidence-based guidelines to direct prescribing
Use evidence-based medicine to identify if patient is beyond lifestyle changes only
Use frequent visits to predict patient outcomes
Use genetic testing to confirm or reject complex condition
Use gene site testing to recommend medications
Use gut instinct and investigation to identify drug abuse
Use handholding to establish trust
Use hands as the only tools
Use history and physical exam to identify risk
Use IM websites to further education
Use iterative conversations to educate & align on health goals
Use journaling to identify pain triggers and predict outcomes
Use labs to measure or predict outcomes
Use lifestyle impact to identify risk level
Use Light Touch Therapy to Reduce Pain
Use Literature to get Recommendations
Use long intake session to drive decisions
Use MAP system to assess controlled substance risk
Use meditation and lifestyle changes to achieve holistic results
Use NP Therapeutic Order
Use pain management conferences to increase knowledge
Use patient history to perform root cause analysis
Use patient interview to learn the back story
Use patient medical history to determine risk
Use Patient QOL Goal as Anchor for Root Cause Analysis
Use Physical Exam as a Predictive Tool
Use practice parameters to make recommendations based on diagnosis
Use protocols based on diagnosis to recommend treatment & meds
Use PubMed and journals to identify recommendations
Use root cause analysis to individualize care
Use risk stratification model for provider specialty
Use screening questionnaires to predict outcomes
Use several visits to establish patient trust
Use social media to identify new terms or trends to research
Use social workers to find resources for patients in need
Use Spirituality as **Driver for Physical Movement**
Use subjective findings
Use subjective pain scale as tool to predict outcome
Use support garments instead of meds for pregnant patients

Use the interview to understand the patient story
Use ultrasound to predict risk in pregnant patients
Value Patient's Goals
View patient info on a timeline to take IM and functional approach
Walk into patient room without bias based on their level of insurance
Work with Supporting MD to Prescribe

Table J3: Integrative and Allopathic Medicine Comparisons

IM AND ALLOPATHIC MEDICINE COMPARISONS
Allopathic doctors accepted & tested for incorrect diagnosis
Allopathic focuses on symptoms not root cause analysis
Allopathic has important role, handles urgent needs
Allopathic medicine doesn't empower patients
Allopathic medicine doesn't support gradual recommendations
Allopathic medicine instructions can confuse patients
Allopathic medicine is an assembly line
Allopathic medicine is formulaic
Allopathic medicine is valuable
Allopathic medicine uses technology early versus physical exams
Allopathic model doesn't consider the positive health factors
Allopathic provider aggressively pushed a health protocol
Chiropractic approach is conservative, less litigious
Conventional medicine visits are too short to push IM
IM Dietary changes have better effects than allopathic meds
Doctors have different definitions of IM
Experience grows IM provider intuition
History of chiropractic vs American Medical Association (AMA)
Holistic approach requires understanding of options
Holistic care requires helping the patient heal
Holistic medicine requires asking additional questions
Homeopathic remedies may require patient education
Hospitals have more control to take pain scores frequently
Ignorance of naturopathy reduces willingness to refer
IM addresses cancer side effects
IM considers every modality
IM considers preventative medicine before surgery
IM delivers results because providers invest more time in understanding
IM intuition includes ability to read non-verbal communication
IM is patient-focused
IM is the future
IM promotes health
IM providers all need bias training
IM root cause analysis is different from allopathic

IM requires lifestyle change to promote overall wellness
IM requires more time like a 45-min consultation
IM requires open mind from patient, family, & care community
IM requires patient-provider team
IM requires patient-provider communication
IM requires the use of specialists with time to focus on pain
IM requires therapeutic alliance between provider and patient
IM uses the operating room as the last resort
It's easier to take IM approach with patients who are not pregnant
Longer assessment allows patients to avoid potential harm
MDs may request unneeded tests
Mental health requires talk therapy and subjective measures
Mental health training increases active listening skillset
Naturopaths use a health model not a disease model
Providers lean on their training, expertise, and intuition first
Providers who prescribe pain meds need retraining
Shifting to holistic medicine benefits patients & providers
Short visits may not be able to truly cover pain
The current US Healthcare system is broken
Time is critical factor in medical practice
Tracking lifestyle may become an afterthought in primary care
US skepticism about chiropractic exists
Unconscious bias exists in Healthcare

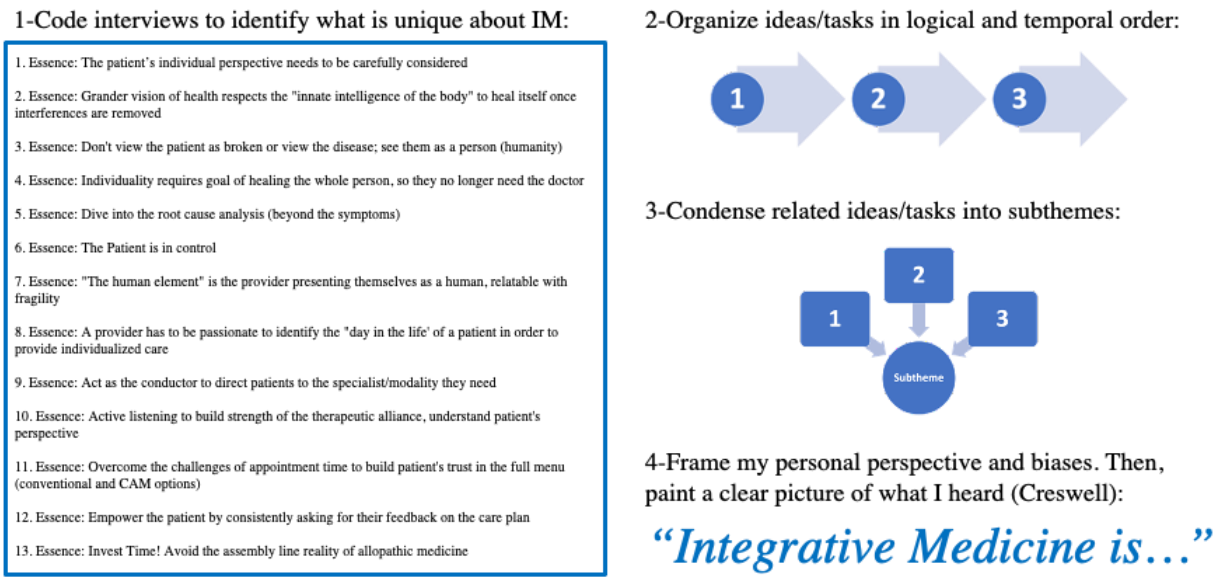


Figure J1-Method for Phenomenological Storyboarding, Identifying Essence

Table J4: Perceptions of PPA by Screenshot

PPA PERCEPTION BY SCREENSHOT
Screenshot 1 - Predictive Analytics
1 Amount of content looks busy
1 Avoiding race bias is good
1 Black box predictions don't support individualized care
1 Blanket Statements could be Inaccurate
1 Captures Useful information about patient's living situation
1 Change color scheme, add blues and greens, less red
1 Clinical Risk Factors are Positive
1 Clunky Interface
1 Color scheme doesn't make it easy to identify areas of focus
1 Color scheme is hard to differentiate
1 Colors are too similar
1 Concerns about the reliability of the information
1 Could Bias Decision Making
1 Different Columns in one view is good
1 Doesn't Provide enough mental health considerations
1 Doesn't visualize psycho-social barriers to health
1 Dynamic of Health Not represented in Time Spans
1 Easy to Navigate
1 Easy to quickly see information
1 Easy to understand patient trend (orange to red)
1 Filters at top are easy to use
1 Helps providers choose more aggressive steps to keep patient out of the hospital
1 Highlighting high-risk patients is useful
1 Improve the Color Contrast
1 Insurance information helps understand if patient can get medications
1 Issue with Visualization of Dots
1 It's unclear how insurance impacts risk
1 Iterative Status Change Supports Process
1 Lack of comorbidities makes her question PPA
1 Lack of visibility into readmission cause (chief complaint or something new)
1 Lack of visibility into the care community for the patient
1 Lacks context
1 Looks busy
1 More Information is Needed to Reduce Medical Error
1 More information Needed on How Algorithm Determined Risk
1 Neutral idea that a lot of info will create screen clutter
1 Neutral musing about how the input was calculated
1 Neutral response about why these headers were chosen
1 Neutral response about accessible patient information
1 Organization of information is good
1 Payer Data isn't Needed for Providers who Don't take Insurance

1 Pigeonholes patients
1 PPA will mirror the clutter in EMR due to amount of information to surface
1 Presentation is Clear
1 Presentation is straightforward
1 PTSD and Anxiety caused by visualization
1 Race not being captured is good
1 Red and orange dots are hard to differentiate
1 Red for High risk is good
1 Reminders Help Providers Avoid Failure
1 Reminders helps provider cover themselves
1 Reminders of things to consider is useful
1 Risk categories are helpful
1 Risk factors are positive
1 Screenshot is clunky
1 Seems Applicable to Hospitals
1 Sharing Predictions with Patients Leads to Negative Outlooks
1 Should have fewer rows
1 Simple for User with Basic Skillset
1 Socioeconomic factors may trigger certain providers
1 Sorting features are good
1 Surfaces a lot of valuable information
1 Surfacing insurance payer could introduce bias
1 User experience is neutral aesthetically
1 Visualization of dots isn't appealing
Screenshot 2 - Prescriptive Analytics
2 Accuracy of Historical Data Impacts PPA Outputs
2 Additional information supports care planning for release from hospital
2 Background information helps Provider Show Bedside Manner
2 Brief patient snapshot is helpful
2 Clinical risk factors and laboratory information is helpful
2 Clinical risk factors may be helpful
2 Color scheme is not good-needs more color
2 Comprehensive view is not bad
2 Concern that uninsured patients would get different outputs
2 Consideration of Options Based of Individual Factors Has Value
2 Cookie Cutter Protocols don't support IM
2 Date added to the system not helpful
2 Does the patient research for the provider
2 Doesn't calculate age automatically
2 Doesn't highlight what is current versus resolved
2 Doesn't Support Preventative Medicine
2 Has Value for Extreme Cases (e.g., Death Risk)
2 Has value for new mental care professionals
2 Helps IM provider create better care plan
2 If payer name means nothing, remove it

	2 Improve user interface & add colors
	2 Income Doesn't Factor in Choices a Patient Makes
	2 Insurance Payer is Irrelevant to Care Decisions
	2 Interventions list may help save time
	2 Is too generic
	2 Is very comprehensive
	2 Lack of color scheme makes it hard to know where to focus
	2 Lacks Drill down into diagnosis and clinical factors
	2 Less helpful for mental health professions who assess patients effectively
	2 Less Negative than screenshot 1
	2 List of Interventions Provides Reminders
	2 List of issues should be grouped by ICD code
	2 Living alone status is more important than marriage status
	2 More diagnosis history is needed
	2 More visually appealing than screenshot 1
	2 Neutral reaction to new information moving closer to holistic approach
	2 Patients Appreciate Not Having to Repeat History with Every Provider Visit
	2 Payer name should not introduce bias
	2 Provides prompts on which additional providers & support to coordinate
	2 PPA Discrepancy May Require Audit of Data Inputs
	2 PPA Doesn't take into Account Patient Presentation
	2 Presentation is busy, but serves a purpose
	2 Protocols Support Critical Conditions better than Chronic Conditions
	2 Provides Aggregate Data to Support Intake
	2 Provides more behind-the-scenes information
	2 Provides more input on WHY a patient has a certain risk score
	2 Provides patient snapshot that informs first steps
	2 Provides understanding of patient lifestyle
	2 Provides value like care gaps identified by some EMR systems
	2 Providing risk factors is valuable
	2 Recommendations are too Generic
	2 Reminders are Especially Helpful if the Outcome of Missing is Dire
	2 Replaces Need to Review Large Volume of Documents
	2 Requires orientation or help to digest large amount of data
	2 Requires time to understand what content is presented
	2 Risk Factors Are Presented Simply
	2 Socioeconomic Data Supports Selection of Appropriate Interventions
	2 Socioeconomic factors like education may create bias
	2 Some socioeconomic risk factors are very helpful
	2 Summarizes large amount of data
	2 Surfaces IM Options to Educate Allopathic Providers
	2 Too Much Content on Screen
	2 Topics presented are extremely helpful
	2 Unclear if this is point in time data or representing a trend
	2 Understanding socioeconomic factors helps identify barriers to access

2 Visualization of socioeconomic risks has value
Color Code 2 To Make Key Content Stand Out
Screenshot 2 Presents Better Than Screenshot 1
Screenshot 3 Interventions, Recommendations
3 Age without having to calculate is helpful
3 All purple makes it difficult to differentiate sections
3 Allowing provider to accept or reject a recommendation is valuable
3 Allows ML to Occur, Better over Time
3 Allows others to see your action on the recommendations
3 Benzo Encounters risk lacks information
3 Best screenshot - shows care gaps similar to EMR
3 Big Picture Summary is Similar to Notation IM Provider Currently Captures
3 Capturing status allows provider to update over time
3 Comprehensive view of information is good
3 Data presented best out of the three screenshots
3 Drop down increases accountability
3 Functionality Lacks Ability to Add Context
3 Keeps the provider on their toes, to not miss information
3 Knowing status of other's actions is helpful
3 Lack of clarity on the nature of the issue
3 Lack of Visibility into How PPA Makes Recommendation causes Doubt
3 Lack of visibility into how long the issue has existed
3 Lack of visibility into whether risk factors are primary or secondary
3 List Provides Reminders for Providers to Ask About Previous History
3 Lists Provider Reminder of What to Ask the Patient
3 Length of stay (LOS) is helpful for hospitalists
3 Makes it easier to distinguish areas of content
3 Medical Decision-Making is More Dynamic Than Drop-Down Menu
3 More information is needed about the risk factors
3 More information on drug encounters is needed
3 Presents information in a more focused way
3 Presenting Comorbidities helps providers reconsider treatment plan
3 Prompts are useful for busy professionals
3 Provider Did not Like Patients Being Ranked
3 Providers Less Likely to Choose Unfamiliar Recommendations
3 Providing Clear Snapshot Creates Individualized View
3 Purple color scheme is not differentiated enough
3 Recommendations Lack Individualization
3 Recommendations Shouldn't be Applied Generically
3 Requires a learning curve to understand information presented
3 Screen looks busy
3 Selected Status Could Be Used to Judge Physicians
3 Selecting Status Makes Assumption Provider is following Pre-Set Protocol
3 Sort feature is user friendly
3 Status drop down is fair

3 Supports Groups of Data Captured in IM Assessments
3 Surfacing Patient support system is valuable
3 Surfacing Patient's Ethnicity would introduce bias
3 Tracking Acceptance of Recommendations Has Value
3 Tracking actions helps practice managers audit treatment protocols
3 Unclear if Recommendation is Standard of Care
3 Visualizing status helps provider know what's outstanding
3 Works for Hospitals, Makes Finding Information Efficient

Table J5: Healthcare Scenarios Best Supported by PPA

SCENARIOS BEST SUPPORTED BY PPA
Best for complex patients
Best for pain patients with obvious cause (like a fall)
Best for patients who may fall through the cracks
Best for preventative care
Best for systems that already have well-defined risk scoring
Best used as tool to educate provider on patient history
Best used in patients with one well-understood issue like diabetes
Best for management of chronic emergent disease
PPA fits chronic disease patients with well understood actions & treatments
Best for providers using factors to prescribe medication
Best for providing recommendations a provider may miss
Hospitalists using PPA share risk scores to primary care provider
PPA supports mental health safety assessment
PPA has more value making recommendations using mental health questionnaires
PPA is suitable for educating all types of patients
PPA is well suited for titrating patients off medications over time
PPA makes performing intake, cataloguing, and retrieving data more efficient
PPA provides information which can make the visit experience more engaging
PPA provides workflow for what to do with the patient
PPA supports emergency scenarios best
PPA surfaces information providers don't always remember

Table J6: Current Limitations of PPA (Negative Perception)

CURRENT LIMITATION OF PPA
AI and machine learning fan questions PPA Healthcare application
Algorithms based on allopathic medicine is a sick society model
Automatically suggesting a medication would increase doubt in PPA
Data input error reduces PPA accuracy
Denying a patient care based on PPA is inappropriate
Doubt about ability to apply predictive analytics to individuals
Doubt that PPA support aggregate data needs of IM

	Downstream provider ease, confidence relies on upstream data entry
	Focus on lists distracts from focus on outcomes
	Human error in data entry creates doubt about PPA
	Inability to process non-verbal communication creates doubt in PPA
	Inconsistency is data entry causes provider to doubt PPA
	Incorrect data input would cause doubt of results
	Lack of visibility causes provider to doubt PPA
	Lack of visibility into algorithms causes doubt
	Low reliability would cause doubt in PPA
	Obvious errors would create doubt in PPA
	Patients may reject data transparency needed to support PPA
	Physiology of women in labor is not going to fit the algorithm
	PPA can't predict suicide
	PPA could push allopathic doctors to pigeonhole patients
	PPA creates latency issue, impact of real time info
	PPA designed without patient input increases doubt in the system
	PPA dictated care based on insurance is negative
	PPA doesn't capture patient feedback about medication
	PPA doesn't consider impact of racial bias
	PPA doesn't consider medicine/treatment compliance
	PPA doesn't consider physical presentation of patient
	PPA doesn't consider subjective factors
	PPA doesn't manage subjective conditions
	PPA doesn't support functional screening
	PPA doesn't support real time data
	PPA doesn't track data chiropractors need
	PPA grouping of people is a problem in medicine
	PPA has incorrectly predicted psychiatric hospital admittance
	PPA has limitations for patient surrogate & interpreter situations
	PPA is not a fit for CAM or holistic medicine
	PPA is not a good fit for depressed patients with complicated histories
	PPA is surfacing too much information, looks busy
	PPA lacks holistic considerations
	PPA limitation is the massive amount of data needed to be accurate
	PPA is limited to people with internet
	PPA may not be able to surface sealed mental health records
	PPA is not fit for capturing information from patients who have guardians
	PPA results that go against provider intuition would cause rejection
	PPA that doesn't consider less invasive modalities would be met with doubt
	PPA tools could make practitioners lazy
	PPA wasn't designed for body workers
	PPA wasn't designed for paper-based practitioners
	Rejection of PPA for clinical decision-making
	Removal of human interaction would increase doubt of PPA
	Socioeconomic labels have negative connotations

Systems often create a transcription burden
Test or imaging results may distract from root cause of pain

Table J7: Beliefs and Attitudes on Future Convergence of IM and PPA

BELIEFS AND ATTITUDES ON FUTURE CONVERGENCE OF IM AND PPA
Belief in PPA improvement did not reduce doubts about future accuracy
Convergence should occur if providers aren't relying solely on PPA
Convergence could occur to provide toolkit of treatment options
Convergence doesn't support reality of complex patients
Convergence is inevitable due to general acceptance of technology
Convergence of prescriptive analytics using generalization should not occur
Convergence should occur with accurate data inputs
Convergence will occur because AI is more accurate than human decision-making
Convergence will occur because PPA is already in use
Convergence will occur because PPA reconciles so much information
Future PPA can educate providers on treatment options
Future PPA should not reduce human interaction
Future PPA gives insights via mobile devices
Future PPA must aid not introduce additional time constraints
Future PPA must consider barriers to care
Future PPA requires future EMR
Future PPA requires insurance payers to see value
Future PPA that tracks lifestyle highlights additional things providers miss
Future PPA will be driven by epigenetics
Future PPA will be used to convince patients of their risk and educate them on benefits of lifestyle change
Future PPA will give additional options for providers to consider
Future PPA will incorporate IM and Allopathic
Future PPA will require patient reported data
Future PPA will use lab data and patient outcomes to drive machine learning
Future state systems (EHR) should reduce manual transcription
Future systems should surface conventional & CAM recommendations
Hacking risk reduces comfort with total PPA dependence
Ideal PPA requires integration between IM and allopathic systems
Monitoring of dynamic data will improve PPA value
PPA will help IM when patients shift to emergency issues
PPA will surface next steps for patients with severe conditions
PPA confidence requires big data input
PPA could unify medical practice via visibility into holistic patient
PPA is inevitable but hurts art of medicine
PPA is not going away
PPA needs rethinking for convergence to occur
PPA needs to be tweaked for convergence
PPA replacement of mental health evaluation is unlikely

PPA replacing decision-making is unlikely
PPA should inform IM decisions but not dictate them
PPA should not determine admittance to mental health facility
PPA use will increase 200%
PPA will be a good start to helping patients but requires provider root cause analysis
PPA will be adopted in 10 years
PPA will be an adjunct not a replacement of human decision
PPA will be education tool for providers who weren't trained to think holistically
PPA will be more readily used in 10 years
PPA will be used in primary care & IM in 10 years
PPA will clarify decision-making and identify details providers forget
PPA will create ROI, thus will be adopted
PPA will depend on future interoperability
PPA will have same human data entry errors as paper
PPA will integrate with IM-specific EHR
PPA will not remove human element (chaos)
PPA will not replace decision-making
PPA will not replace human discernment
PPA will not replace sports medicine decision-making
PPA will reduce mistakes caused by missing information
PPA will remind doctors which medications to use
PPA will replace the surgical clearance visit
PPA will require connected patients with at-home devices
PPA will support decision-making but not replace it
PPA will take over in 10 years
PPA will use lab data to identify contraindications to medications
PPA will use labs to identify sexually transmitted infection (STI) treatment
PPA won't replace value of physical presentation
Provider expertise trumps system recommendations
Provider trusted PPA due to generational trust of technology
Separation of medical disciplines makes holistic PPA difficult to achieve
The future of non-emergency scenarios is individualized care

Table J8: Proposed PPA Modifications, Additional Inputs & Outputs

PROPOSED PPA MODIFICATIONS, ADDITIONAL INPUTS & OUTPUTS
Add bi-directional communication, messaging
Add task management workflow
Adding correlation of lifestyle change to outcome would impact patient behavior
Allow addition of notes
Allow provider to deselect or reduce value of risk factors
Automate data capture of visit summaries
Capture concomitant medications and show interactions

Capture patient compliance to understand their mentality towards change
Choose colors that make status easier to see
Drill down into risk factor bullet point for more context
Future PPA should use patient input-market research
Imaging capability is needed for PPA to compete with EHR
Include subjective measures
Inclusion of imaging could expose trends
Integrate with specialty labs
Interoperability, federated data is needed
PPA algorithms should mirror evidence-based practice
PPA must collect data to present metrics while saving time
PPA recommendations must be designed based on IM protocols
PPA should calculate hydration goals based on patient weight
PPA should identify areas of follow up based on genetic testing
PPA should allow drills downs into red flag opioid risk scores
PPA should allow dynamic data entry, add or remove history elements
PPA should allow note boxes for free text entry of additional data
PPA should allow patients to review contract via mobile/web
PPA should allow providers & patients to select status of behavior change
PPA should allow providers to refine modality menu, educate patient on options
PPA should allow selection of multiple providers in patient chart
PPA should amplify social workers' role
PPA should surface clinical determination and allow providers to override it
PPA should automate referral message like the eClinical Works system
PPA should blind factors that could cause bias
PPA should calculate morphine dose equivalent
PPA should calculate time to next outpatient mental health visit
PPA should capture baseline & ongoing snapshot of antipsychotics' impact
PPA should capture lifestyle in patient health questionnaire (PHQ)
PPA should capture mental health safety assessment answers
PPA should capture objective mental health factors like hospitalization frequency
PPA should capture pain scores over time
PPA should capture past & current meds, current physical symptoms
PPA should capture patient feedback
PPA should capture patient-reported happy face scores for pain
PPA should capture previous injuries
PPA should capture QOL improvements (outside of the pathology)
PPA should capture real-time pain scores
PPA should capture some tests more frequently
PPA should collect visit summaries with short- & long-term treatment strategy
PPA should complement not replace the physician
PPA should connect physical exams to impact of predictions
PPA should connect to the pharmacy and track compliance with medications
PPA should connect with state automated prescribing system
PPA should consider patient feedback in lifestyle suggestions

PPA should correlate lifestyle to patient reported outcomes, subjective scores
PPA should educate the patient on modality options based on the diagnosis
PPA should flag issues based on patient history
PPA should have alerts if pain contract is being broken
PPA should highlight abnormal lab results
PPA should highlight the patient's priorities
PPA should identify barriers to care for specialists
PPA should identify resources based on need and insurance coverage
PPA should include additional section for habits
PPA should include and measure QOL, blisters or positive markers
PPA should include drop down of all diagnoses
PPA should include the why-physician goals & reason for prescribing medications
PPA should integrate with EMR to track referrals
PPA should integrate with note-taking system to capture interviews
PPA should link to medical images listed as a risk factor
PPA should list barriers to care
PPA should make lifestyle tracking front and center
PPA should mirror EMR pharmacy integration & medicine reconciliation
PPA should mirror the iterative way practice parameters are updated
PPA should not take discernment away from providers
PPA should notify social workers added to care community
PPA should predict risk of sending mental health patients back to the home setting
PPA should prioritize interventions by level of importance
PPA should prompt providers to perform necessary follow-up calls or visits
PPA should provide alerts around state-mandated morphine dose equivalence
PPA should provide enough info on risk factors to prompt order of additional tests
PPA should provide hover help that links to articles & guidelines
PPA should provide listings by decision status
PPA should recommend lifestyle changes based on risk
PPA should recommend labs to take based on mental health risk
PPA should recommend placement options for mental health patients
PPA should record functional recovery times
PPA should recommend disposition planning next steps
PPA should reduce need for manual transcription
PPA should reference images found in medical manuals
PPA should share links to patient education info
PPA should show most frequently referred based on specialty and distance
PPA should suggest diet options based on patient history
PPA should support comments on patient charts
PPA should support curation of frequently changing modalities
PPA should support EMR box click functionality to dictate patient history
PPA should support interoperability, capturing data from multiple providers
PPA should support matrix of patient data over time
PPA should support nurse review of screening answers
PPA should support patient reported lifestyle and diet behaviors

PPA should support patient selection of referral providers
PPA should support portability of patient records from system to system
PPA should support real-time data entry & provide feedback to patients
PPA should support real-world documentation workflow, prompts for next steps
PPA should support several different risk models
PPA should support SOAP notes with the assessment and treatment plan
PPA should surface content in disability paperwork
PPA should surface information to social workers to drive care planning
PPA should surface intake information as historical data
PPA should surface key information to newly added care provider
PPA should surface list of CAM providers regardless of insurance
PPA should surface list of medical images by date taken
PPA should surface opioid risk scores from state systems
PPA should surface patient & treating physician's perspective
PPA should surface patient screening on an app
PPA should surface recommendations as a provider workflow
PPA should surface up-to-date resources, websites, and information on NM
PPA should track elements of the pain contract
PPA should track initial lifestyle and changes over time
PPA should track patient satisfaction with provider, staff, & facility over time
PPA should track provider list with contact information
PPA should track providers' visits
PPA should track subjective pain measures with anecdotal data over time
PPA should use objective data like vitals to drive risk areas
PPA should validate algorithms based on patient type (edge cases)
PPA should surface list of past providers
Provide customizable & dynamic workflow to support patient assessment
Recommend alternative medications
Share medical history, past interventions
Sharing protected information will be difficult
Suggest less invasive therapy
Suggest more invasive therapy
Support mental health assessment
Surface recommendations by provider type
Surface recommendations from ecosystem of providers
PPA algorithms should mirror evidence-based practice

REFERENCES

Amy Neil MS, M. (2019). Vitalism–a worldview revisited: a critique of vitalism and its implications for integrative medicine. *Integrative Medicine, 18*(3), 60-73.

Andrew Weil Center for Integrative Medicine. (2021). Retrieved from https://integrativemedicine.arizona.edu/about/index.html

Angehrn, Z., Haldna, L., Zandvliet, A. S., Gil Berglund, E., Zeeuw, J., Amzal, B., . . . Heckman, N. M. (2020). Artificial Intelligence and Machine Learning Applied at the Point of Care. *Frontiers in Pharmacology, 11*, 1-12. Retrieved from https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=edb&AN=143877141&site=eds-live&scope=site&custid=gsu1

Bachhuber, M. A., Saloner, B., Cunningham, C. O., & Barry, C. L. (2014). Medical cannabis laws and opioid analgesic overdose mortality in the United States, 1999-2010. *JAMA internal medicine, 174*(10), 1668-1673.

Barke, A. (January 17, 2019). Chronic pain has arrived in the ICD-11. Retrieved from https://www.iasp-pain.org/PublicationsNews/NewsDetail.aspx?ItemNumber=8340

Barrett, B., Marchand, L., Scheder, J., Plane, M. B., Maberry, R., Appelbaum, D., . . . Rabago, D. (2003). Themes of holism, empowerment, access, and legitimacy define complementary, alternative, and integrative medicine in relation to conventional biomedicine. *The Journal of Alternative & Complementary Medicine, 9*(6), 937-947.

Chen, P.-S., Yu, C.-J., & Chen, G. Y.-H. (2015). Applying task-technology fit model to the healthcare sector: a case study of hospitals' computed tomography patient-referral mechanism. *Journal of medical systems, 39*(8), 1-14.

Chin-Yee, B., & Upshur, R. (2019). Three Problems with Big Data and Artificial Intelligence in Medicine. *Perspectives in Biology & Medicine, 62*(2), 237. Retrieved from https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=edb&AN=137468938&site=eds-live&scope=site&custid=gsu1

Chin-Yee, B., & Upshur, R. (2018). Clinical judgement in the era of big data and predictive analytics. *Journal of evaluation in clinical practice, 24*(3), 638-645.

Ching, T., Himmelstein, D. S., Beaulieu-Jones, B. K., Kalinin, A. A., Do, B. T., Way, G. P., . . . Greene, C. S. (2018). Opportunities and obstacles for deep learning in biology and medicine. *J R Soc Interface, 15*(141). doi:10.1098/rsif.2017.0387

Cohen, I. G., Amarasingham, R., Shah, A., Xie, B., & Lo, B. (2014). The legal and ethical concerns that arise from using complex predictive analytics in health care. *Health affairs, 33*(7), 1139-1147.

Coulter, I., Snider, P., & Neil, A. (2019). Vitalism–a worldview revisited: a critique of vitalism and its implications for integrative medicine. *Integrative Medicine: A Clinician's Journal, 18*(3), 60.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*: Sage publications.

Damery, S., & Combes, G. (2017). Evaluating the predictive strength of the LACE index in identifying patients at high risk of hospital readmission following an inpatient episode: a retrospective cohort study. *BMJ Open, 7*(7), e016921-e016921. doi:10.1136/bmjopen-2017-016921

Davenport, T., & Harris, J. (2017). *Competing on analytics: Updated, with a new introduction: The new science of winning*: Harvard Business Press.

Davis, F. D., F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). *User Acceptance of Computer Technology: A Comparison of Two Theoretical Models.* Management science 35(8): 982-1003.

Dietvorst, B. J., Simmons, J. P., & Massey, C. (2018). Overcoming Algorithm Aversion: People Will Use Imperfect Algorithms If They Can (Even Slightly) Modify Them. *Management science*, *64*(3), 1155-1170. Retrieved from https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=ecn&AN=1803734&site=eds-live&scope=site&custid=gsu1

Dowell, D., Haegerich, T. M., & Chou, R. (2016). CDC guideline for prescribing opioids for chronic pain—United States, 2016. *Jama*, *315*(15), 1624-1645.

Dupre, M. E., Nelson, A., Lynch, S. M., Granger, B. B., Xu, H., Churchill, E., . . . Peterson, E. D. (2017). Clinical Investigation: Socioeconomic, Psychosocial and Behavioral Characteristics of Patients Hospitalized With Cardiovascular Disease. *The American Journal of the Medical Sciences*, *354*, 565-572. doi:10.1016/j.amjms.2017.07.011

Fan, W., Liu, J., Zhu, S., & Pardalos, P. M. (2018). Investigating the impacting factors for the healthcare professionals to adopt artificial intelligence-based medical diagnosis support system (AIMDSS). *Annals of Operations Research*, 1-26.

Franklin, P. D., Zheng, H., Bond, C., & Lavallee, D. C. (2020). Translating clinical and patient-reported data to tailored shared decision reports with predictive analytics for knee and hip arthritis. *Quality of Life Research*, 1-8.

Geng, W., Qin, X., Yang, T., Cong, Z., Wang, Z., Kong, Q., . . . Jiang, L. (2020). Model-Based Reasoning of Clinical Diagnosis in Integrative Medicine: Real-World Methodological

Study of Electronic Medical Records and Natural Language Processing Methods. *JMIR Med Inform, 8*(12), e23082. doi:10.2196/23082

Goodhue, D. L. (1995). Understanding user evaluations of information systems. *Management science, 41*(12), 1827-1844.

Goodhue, D. L., Klein, B. D., & March, S. T. (2000). User evaluations of IS as surrogates for objective performance. *Information & Management, 38*(2), 87-101.

Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. *Mis Quarterly*, 213-236.

Grol-Prokopczyk, H. (2017). Sociodemographic disparities in chronic pain, based on 12-year longitudinal data. *Pain, 158*(2), 313.

Hahn, T., Nierenberg, A. A., & Whitfield-Gabrieli, S. (2017). Predictive analytics in mental health: applications, guidelines, challenges and perspectives. *Molecular psychiatry, 22*(1), 37-43.

Horrigan, B., Lewis, S., Abrams, D. I., & Pechura, C. (2012). Integrative medicine in America—-how integrative medicine is being practiced in clinical centers across the United States. *Global Advances in Health and Medicine, 1*(3), 18-52.

Howard, M. C., & Rose, J. C. (2019). Refining and extending task–technology fit theory: Creation of two task–technology fit scales and empirical clarification of the construct. *Information & Management, 56*(6), 103134.

Isidore, C. (2020). OxyContin maker to plead guilty to federal criminal charges, pay $8 billion, and will close the company. *CNN-Business*. Retrieved from https://www.cnn.com/2020/10/21/business/purdue-pharma-guilty-plea/index.html

Janevic, M. R., McLaughlin, S. J., Heapy, A. A., Thacker, C., & Piette, J. D. (2017). Racial and socioeconomic disparities in disabling chronic pain: findings from the health and retirement study. *The Journal of Pain, 18*(12), 1459-1467.

Kansagara, D., Englander, H., Salanitro, A., Kagen, D., Theobald, C., Freeman, M., & Kripalani, S. (2011). Risk prediction models for hospital readmission: a systematic review. *Jama, 306*(15), 1688-1698. doi:10.1001/jama.2011.1515

Katz, J., Weinrib, A., Fashler, S. R., Katznelzon, R., Shah, B. R., Ladak, S. S., . . . Santa Mina, D. (2015). The Toronto General Hospital Transitional Pain Service: development and implementation of a multidisciplinary program to prevent chronic postsurgical pain. *Journal of pain research, 8*, 695.

Kuehn, B. (2018). Chronic pain prevalence. *Jama, 320*(16), 1632-1632.

Lee, A. C. C., & Kemper, K. J. (2000). Homeopathy and Naturopathy: Practice Characteristics and Pediatric Care. *Archives of Pediatrics & Adolescent Medicine, 154*(1), 75-80. doi:10-1001/pubs.Pediatr Adolesc Med.-ISSN-1072-4710-154-1-poa9145

Lin, Y.-K., Chen, H., Brown, R. A., Li, S.-H., & Yang, H.-J. (2017). Healthcare predictive analytics for risk profiling in chronic care: A Bayesian multitask learning approach. *Mis Quarterly, 41*(2).

Lodhi, M. K., Stifter, J., Yao, Y., Ansari, R., Keenan, G. M., Wilkie, D. J., & Khokhar, A. A. (2015). *Predictive modeling for end-of-life pain outcome using electronic health records.* Paper presented at the Industrial Conference on Data Mining.

Madsen, C., Vaughan, M., & Koehlmoos, T. P. (2017). Use of integrative medicine in the United States military health system. *Evidence-Based Complementary and Alternative Medicine, 2017*.

Maedche, A., Legner, C., Benlian, A., Berger, B., Gimpel, H., Hess, T., . . . Söllner, M. (2019). AI-based digital assistants: opportunities, threats, and research perspectives. Bus Inf Syst Eng 61: 535–544. In.

Majeed, M. H., Ali, A. A., & Sudak, D. M. (2018). Mindfulness-based interventions for chronic pain: Evidence and applications. *Asian journal of psychiatry*, *32*, 79-83.

Mathiassen, L. (2017). Designing engaged scholarship: From real-world problems to research publications. *Engaged Management Review, 1*(1), 2.

Mathieson, K., & Keil, M. (1998). Beyond the interface: Ease of use and task/technology fit. *Information & Management, 34*(4), 221-230.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*: sage.

Miner, L., Bolding, P., Hilbe, J., Goldstein, M., Hill, T., Nisbet, R., . . . Miner, G. (2014). *Practical predictive analytics and decisioning systems for medicine: Informatics accuracy and cost-effectiveness for healthcare administration and delivery including medical research*: Academic Press.

Moustakas, C. (1994). *Phenomenological research methods*: Sage publications.

Mueller-Peltzer, M., Feuerriegel, S., Nielsen, A. M., Kongsted, A., Vach, W., & Neumann, D. (2020). Longitudinal healthcare analytics for disease management: Empirical demonstration for low back pain. *Decision Support Systems*, 113271.

Myers, M. D. (2019). *Qualitative research in business and management*: Sage Publications Limited.

Naliboff, B. D. (2002). Understanding and Managing Chronic Pain. *International Foundation for Functional Gastrointestinal Disorders*.

Nambiar, R., Bhardwaj, R., Sethi, A., & Vargheese, R. (2013). *A look at challenges and opportunities of big data analytics in healthcare.* Paper presented at the 2013 IEEE international conference on Big Data.

Noble, S. U. (2018). *Algorithms of oppression*: New York University Press.

Oberg, E. B., Bradley, R., Cooley, K., Fritz, H., Goldenberg, J., & Seely, D. (2015). Estimated effects of whole-system naturopathic medicine in select chronic disease conditions: A systematic review. *Altern Integr Med, 4*(2), 1-12.

Oesterreich, T. D., Fitte, C., Behne, A., & Teuteberg, F. (2020). Understanding the Role of Predictive and Prescriptive Analytics in Healthcare: A Multi-Stakeholder Approach.

Ohnuma, T., Shinjo, D., Brookhart, A. M., & Fushimi, K. (2018). Predictors associated with unplanned hospital readmission of medical and surgical intensive care unit survivors within 30 days of discharge. *Journal Of Intensive Care*, *6*, 14-14. doi:10.1186/s40560-018-0284-x

Pang, R., Wang, S., Tian, L., Lee, M. C., Do, A., Cutshall, S. M., . . . Chon, T. Y. (2015). Complementary and integrative medicine at Mayo Clinic. *The American Journal of Chinese Medicine*, *43*(08), 1503-1513.

Peterson, E. D. (2019). Machine learning, predictive analytics, and clinical practice: can the past inform the present? *Jama*, *322*(23), 2283-2284.

Prosperi, M., Min, J. S., Bian, J., & Modave, F. (2018). Big data hurdles in precision medicine and precision public health. *BMC medical informatics and decision making, 18*(1), 139. doi:10.1186/s12911-018-0719-2

Raghupathi, W., & Raghupathi, V. (2014). Big data analytics in healthcare: promise and potential. *Health information science and systems, 2*(1), 3.

Regulated States and Regulatory Authorities. (2020). Retrieved from https://naturopathic.org/page/RegulatedStates

Reiman, A., Welty, M., & Solomon, P. (2017). Cannabis as a substitute for opioid-based pain medication: patient self-report. *Cannabis and cannabinoid research, 2*(1), 160-166.

Robinson Country Intelligence Index, Georgia State University. (2020).

Saldana, J. (2011). *Fundamentals of qualitative research*: OUP USA.

Saldaña, J., & Omasta, M. (2016). *Qualitative research: Analyzing life*: Sage Publications.

Schneiderhan, J., Clauw, D., & Schwenk, T. L. (2017). Primary care of patients with chronic pain. *Jama, 317*(23), 2367-2368.

Shirani, A. I., Tafti, M. H., & Affisco, J. F. (1999). Task and technology fit: a comparison of two technologies for synchronous and asynchronous group communication. *Information & Management, 36*(3), 139-150.

Sniderman, A. D., D'Agostino Sr, R. B., & Pencina, M. J. (2015). The role of physicians in the era of predictive analytics. *Jama, 314*(1), 25-26.

Snyderman, R., & Weil, A. T. (2002). Integrative medicine: bringing medicine back to its roots. *Archives of Internal medicine, 162*(4), 395-397.

Suryaningrum, D. H. (2012). Assessing individual performance on information technology adoption: A new model. *Global Journal of Business Research, 6*(4), 111-125.

Treede, R.-D., Rief, W., Barke, A., Aziz, Q., Bennett, M. I., Benoliel, R., . . . First, M. B. (2019). Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). *Pain, 160*(1), 19-27.

U.S. Map. (2021). Retrieved from https://coronavirus.jhu.edu/us-map

Van Manen, M. (1990). Beyond assumptions: Shifting the limits of action research. *Theory into practice, 29*(3), 152-157.

Van Manen, M. (2016). *Phenomenology of practice: Meaning-giving methods in phenomenological research and writing*: Routledge.

Wardle, J. L., Adams, J., Lui, C.-W., & Steel, A. E. (2013). Current challenges and future directions for naturopathic medicine in Australia: a qualitative examination of perceptions and experiences from grassroots practice. *BMC complementary and alternative medicine, 13*(1), 15.

Young, L., & Kemper, K. J. (2013). Integrative care for pediatric patients with pain. *J Altern Complement Med, 19*(7), 627-632. doi:10.1089/acm.2012.0368

Zejf, J., Snider, P., & Myers, S. (2019). Naturopathic Model of Healing—The Process of Healing Revisited. *Integrative Medicine: A Clinician's Journal, 18*(4), 26.

Zigurs, I., & Buckland, B. K. (1998). A theory of task/technology fit and group support systems effectiveness. *Mis Quarterly*, 313-334.

VITA

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Osie Gaines helps clients innovate, plan for business transformation, and adopt new ways of working. He is the CEO of Osie Gaines Consulting, LLC where he focuses on the following areas:

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He most recently served as a Senior Director for the Healthcare and Life Science practice at Slalom Consulting. He managed sales, consultant teams, client engagements, and technology partner relationships with Amazon, Google, Microsoft, and Salesforce. Osie led Slalom's 2020 global mentoring program to connect Black employees with mentors and professional development opportunities across the US, UK, and Canada.

Osie is an experienced team leader and consensus builder with nearly 20 years of success in business development, management consulting, program/project management, and training. He has a diverse background, including successful product launches with three technology start-ups in the US, UK, and Ireland. Previously, Osie worked in Accenture's Accelerated Life Sciences and Services practice where he helped global organizations plan and execute Digital Health initiatives. In fiscal year 2017, he served as the Innovation Lead for Accenture's practice.

In 2021, Osie earned his Doctor of Business Administration degree from the Robinson School of Business at Georgia State University. He holds a Master of Science degree in Information Systems from Georgia State University and a Bachelor of Science degree in Human Biology from Michigan State University. Osie earned his Leading Innovation certification from the Stanford University Center for Professional Development. He has practiced as a certified Project Management Professional (PMP) through the Project Management Institute since 2008.

Osie resides in Stone Mountain, GA with his wife Dr. Michelle Gaines who is a nanomaterial and block copolymer science researcher, Professor of Chemistry at Spelman College, and advocate for Black women in STEM (Science, Technology, Engineering, and Mathematics). Osie and Michelle have two wonderful children, Penelope and Osie Lee. The family enjoys fun at the beach, hiking, camping, and gardening. Osie is a dutiful consultant for his daughter's boutique clothing company. Osie is a proud Scoutmaster for his son's troop (Boys Scouts of America, Troop 1833).