Pittsburgh Health Data Alliance

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# Project Overviews

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# Current Project Overviews

## *CHP VIEW*

### PROJECT SUMMARY

CHP VIEW aims to improve outcomes of hospitalized children by predicting critical deterioration outside of the pediatric intensive care unit (PICU). Inpatient critical deterioration is a severe worsening of a hospitalized child's condition that can cause lifelong disability or death. These fast, unexpected changes can lead to transfer to PICUs, where a patient might receive intubation, cardiopulmonary resuscitation, transfusion, or serious outcomes that can increase the cost per admission by approximately $100,000. Every year in the U.S., about 500,000 children are admitted into the PICU, and 1 in 3 will sustain long-term neurological defects that add a $3 billion healthcare burden.

Many critical deterioration episodes are preventable, but objective indicators are often unrecognized. To prevent deterioration, lifelong disability, or death, clinicians must efficiently synthesize enormous quantities of data and translate the information into a decision. In addition, clinicians must weigh the potential costs of inaction against the possibility of overtreatment, which may lead to unnecessary expenditures and exposure to potential iatrogenic injury.

CHP VIEW is an Intelligence Augmentation system that monitors hospitalized children and identifies subtle trends that precede critical deterioration and admission to the PICU. The data are synthesized into clear, actionable information for clinicians that might otherwise miss these time-sensitive signals in the demanding hospital setting. CHP VIEW works using a data pipeline, machine learning algorithm, and clinician user interface developed at UPMC Children's Hospital. A large but select subset of raw electronic record data is analyzed in real-time and translated into a probability of impending deterioration. Clinicians are presented with frequently updated probabilities that are a measure of the risk of impending deterioration.

CHP VIEW can be incorporated into protocolized decision-making frameworks that include required actions and can also nudge clinician decisions without mandating a specific action. The tool is adaptive and can iteratively and automatically retrain and recalibrate as care evolves. While CHP VIEW is currently focusing on pediatric patients at UPMC Children's Hospital, the technology can be scaled to adult patients and hospital systems outside of UPMC.

### RESEARCHERS

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### CURRENT STATUS

A prototype is being developed for deployment at UPMC Children's Hospital in 2022.

# Completed Project Overviews

## *Aviva*

### PROJECT SUMMARY

5.7 million patients are admitted to Intensive Care Units (ICUs) in the United States each year. Optimal evidence-based care for ICU patients is delivered by a multidisciplinary team, who round on patients with an accompanying computer workstation-on-wheels (WOW). However, the team must process many tasks and often fail to provide consistent evidence-based care, leading to preventable morbidity and mortality. An alternative and highly innovative approach is to leverage the WOW as a 'smart' listener and oral prompter, supporting checklist completion through dynamic adaption and interaction with the interprofessional care team at the point of care, offering an efficient approach to increase evidence-uptake, which has been shown to improve ICU outcomes.

The team's solution, Aviva, is a voice-interactive virtual assistant that listens to the team rounding discussion, identifies gaps in the use of evidence-based practices, and selectively prompts the team to consider evidence-based practices when indicated – thus increasing evidence-uptake and improving ICU outcomes. Aviva uses automatic speech recognition (ASR) and natural language processing (NLP) technologies. It is applicable to other team-based care situations in healthcare and across the industry. The project team consists of critical care intensivists, computer scientists, and medical informaticists, and is uniquely poised to develop and deploy this technology to the clinic.

### CURRENT STATUS

The research team is continuing to carry out commercially orientated research on this topic.

### RESEARCHERS

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## *Realtime Evaluation for Adverse Events using Intraoperative Neurophysiological Monitoring (READE-IONM)*

**Machine learning algorithm to automatically mark or identify changes in intraoperative monitoring of brain function**

### PROJECT SUMMARY

Perioperative stroke, defined as stroke that occurs during surgery or within 30 days after surgery, causes significant mortality and disability. Perioperative strokes are severely debilitating, affecting around 50,000 people every year in the US and are expected to rise as operations are increasingly performed on older patients with more complex conditions. The associated direct and indirect costs are approaching $16 billion.

Inadequate identification and treatment of perioperative stroke reduces the clinical effectiveness of the surgical procedure and can lead to disabilities or death. A perioperative stroke occurs from brain ischemia secondary to decreased blood flow to the brain, usually due to a blood clot traveling to the brain. Early identification of large strokes can result in life-saving mechanical clot removal.

Realtime Evaluation for Adverse Events using Intraoperative Neurophysiological Monitoring (READE-IONM) uses a proprietary machine learning algorithm to automatically mark or identify changes in intraoperative monitoring of brain function with an electroencephalogram (EEG), indicating ischemia in all regions of the brain. On detection of ischemia using READE-IONM, the neurologist can recommend interventions to the surgical team, including pausing the surgery or performing lifesaving mechanical clot removal, which can substantially decrease death and disability associated with perioperative stroke.

### CURRENT STATUS

The research team is continuing to carry out commercially orientated research on this topic.

### RESEARCHERS

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## *eMCARE*
## eHealth Mobile Technology Connecting Young Adults to Routine Engagement

### PROJECT SUMMARY

Most young adults between the ages 18-26 in the United States are not prepared for the transition from pediatric to adult care, evidenced by myriad poor health outcomes prevalent in this population such as sexually transmitted infections, unintended pregnancy, depression, anxiety, suicidality, obesity, and suboptimal management of chronic medical conditions, at staggering societal costs. The majority of these health problems are preventable. Young adults tend to forego seeking routine primary care (PC), only presenting to emergency department (ED) or urgent care centers with acute problems. ED providers have neither time nor training to address most health issues identified during treatment and typically recommend primary care follow-up. Unfortunately, per local and national statistics, approximately 70% of these patients never follow-up.

eMCARE, is a two-way, adaptive, automated text messaging (TM) and app-based (planned) system to promote participation of young adults in routine primary care after an ED or urgent care visit. eMCARE conducts brief automated dialogue with participants for up to three months post-ED discharge and tailors messaging and feedback to each individual based on his/her risk factors, presenting problem and motivation level in order to optimally promote PC engagement. Connecting young adults to PC via a system like eMCARE that can be easily integrated into healthcare delivery will address the need and reduce costs associated with annual, preventable healthcare.

### RESEARCHERS

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Co-Founder/CEO of NuRelm

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## *fastMRI (fMRI)*

**MRI scanning method to significantly reduce time and cost of the traditional MRI scan**

### PROJECT SUMMARY

One of the major disadvantages of magnetic resonance imaging (MRI) is the time per exam. A typical clinical exam slot is one hour in length but can extend to be as long as 90 minutes. This limits patient throughput and increases the per-exam cost, which typically is around $1,500 or even higher, due to the high infrastructure costs including equipment maintenance. In addition, extended time spent in the equipment increases stress for patients and their families, in particular in the pediatric population. Long MRI exam time requires sedation for very young patients or other patients who could not otherwise tolerate lying still in the magnet bore for such a long period of time. Current research has shown the harmful effects of sedation (especially repeated sedation) on neurodevelopment in children. Shorter MRI exam times should substantially reduce the number of patients who need sedation.

Reducing the exam time of an MRI scan would, therefore, increase patient comfort and compliance, throughput, and decrease the per-exam cost significantly. This could ultimately improve patient outcome and safety via extending the use of MRI to areas not typically used today, such as replacing X-ray CT scans in patients admitted to the ER with suspected head trauma.

fastMRI (fMRI) is a new type of MRI scanning method that would significantly reduce the time and cost of the traditional MRI scan. The technology involves software incorporating multi-contrast sequences that speed up the exam time, "intelligent" data under-sampling schemes, and machine learning for image reconstruction. fMRI can be applicable to a wide variety of MRI applications, including neurological, musculoskeletal, cardiac, and abdominal imaging.

### RESEARCHERS

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## *Aneurysm Prognosis Classifier (APC)*
**Tool to predict the complication risk of abdominal aortic aneurysms**

### PROJECT SUMMARY

Abdominal aortic aneurysm (AAA) is the 13th leading cause of death in westernized countries. If left untreated, aneurysm growth may lead to high-morbidity aortic rupture. Early endovascular repair is the goal for most AAA treatment tracking regimes, as it reduces overall costs of AAA intervention when compared to direct costs associated with AAA monitoring over a 4-year period. Currently, the only variables clinicians have available to quantify small AAA complication risk are maximum diameter and rate of AAA growth. There are only a small number of software packages that increase rupture risk estimation beyond simple diameter measurements which solely focus on biomechanical properties, do not include patient history (age, gender, BMI, etc.), AAA shape irregularities, or AAA progression over time, and have yet to show predictability in rupture.

Aneurysm Prognosis Classifier (APC) uses the latest advancements in machine learning to predict the complication risk of a small AAA. APC algorithm provides clinicians with an objective, predictive tool to guide surgical intervention decisions before symptoms appear. There are currently companies performing computational simulations reporting traditional wall stress metrics, but they have not demonstrated the ability to predict AAA outcomes consistently.

### RESEARCHERS

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## *Personalized Pain Treatment (PPT)*

**Shared decision-making tool to predict patient's response to various pain treatments**

### PROJECT SUMMARY

Chronic pain impacts more than one third of the U.S. population, generating total annual healthcare costs exceeding $600 billion. A key contributor to the growing financial burden of chronic pain is the fact that patient response to different pain treatments varies dramatically between individuals. As a result, providers making critical therapeutic decisions for managing pain have little idea whether their chosen treatment will be of any benefit to a given patient, leading to repeated treatment failure, reduced quality of life, and increased risk of opioid addiction.

Personalized Pain Treatment (PPT) is a shared decision-making tool that utilizes machine learning to predict an individual patient's response to various pain treatments. The PPT algorithm applies Bayesian analyses to an extensive repository of medical records and patient reported outcomes to generate a report detailing the individualized probability of treatment success. Unlike other personalized medicine prediction tools, which are limited to forecasting drug responses, PPT can also analyze the potential efficacy of physical therapy, psychology, and other non-pharmaceutical treatments, or combinations thereof. Furthermore, PPT is unconstrained by any requirement for the collection and processing of biological samples, allowing the generation of treatment reports in real time at the point of care.

### RESEARCHERS

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## *PI (PathImage) Predictor*

**Computational model that combines pathology and imaging data for breast cancer treatment**

### PROJECT SUMMARY

Each year over 246,660 women are diagnosed with breast cancer in the U.S., with 80% classified as estrogen-receptor-positive (ER+). Currently, ~50% of ER+ breast cancer patients receive adjuvant chemotherapy, which has substantial side effects and toxicity, in addition to the primary treatment (most often surgery or radiation). Only 4% of the patients benefit from these therapies with no recurrence of breast cancer in the next 10 years. Currently, there are only limited risk prediction tools available in the clinic for diagnostic and prognostic testing, and to guide decision-making about whether to offer adjuvant chemotherapy to a patient.

PI-predictor is a computational model that combines standard pathology parameters (a manual version is already available through Magee Womens Hospital) and radiological imaging features obtained via magnetic resonance imaging and digital mammography to replace the Oncotype DX assay. PI-predictor is a fast (<5 mins) and cost-effective method with no additional cost of using clinically readily available pathology and imaging data.

### RESEARCHERS

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## *SPDx – SpIntellx*

### Improving accuracy and efficiency of cancer diagnosis through solid tumor spatial analysis

#### PROJECT SUMMARY

Cancer is a heterogeneous disease composed of various cancer cell, clonal sub populations and other types of cells that comprise the tumor microenvironment (TME). The heterogeneity within the TME is a major challenge for accurate diagnostic and prognostic tests, and the spatial context of the cancer cells and stromal cells, including the migratory immune cells within the TME, must be determined to properly diagnose the specific disease subtype and optimal treatment options.

Spatial Pathology Powers Cancer Diagnostics (SPDx) is a digital pathology software analytics tool that enhances the practice of pathology through the development of new machine learning software tools to computationally guide pathologists' decisions. Unlike competing digital pathology tools that only analyze digital whole slide images…

in the absence of spatial context and intra-tumor heterogeneity, SPDx provides objective and measurable spatial guidance for tissue structures and biomarker relationships that include measures of spatial heterogeneity within the patient's tissue slides. The incorporation of spatial heterogeneity measurement into pathological workflows enables precision medicine approaches to be incorporated into diagnostic and prognostic activities, including prediction of tumor metastases and optimal therapeutic treatment planning. SPDx provides value through faster, quantitative, objective, and more accurate decisions for both current and next-generation digital pathology workflows.

#### CURRENT STATUS

SPDx formed a startup called SpIntellx.

The SpIntellx research team has raised funding from private investors and has also received a Phase I Small Business Innovation Research (SBIR) award from the National Science Foundation.

For more information, visit spintellx.com or reach out to the PHDA at healthdataalliance.com/contact.

#### RESEARCHERS

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## *Clinical Abbreviation Resolution Engine (CARE)*

**Deep learning algorithm to reduce abbreviation misinterpretation within clinical datasets**

### PROJECT SUMMARY

Word sense disambiguation is a fundamental problem, particularly in clinical natural language processing (NLP). High accuracy acronym and abbreviation disambiguation is important for all clinical NLP tasks, as 71% of identified abbreviations in clinical text could be ambiguous in their meanings. Clinical NLP can unlock critical patient case details from unstructured clinical texts, such as patients' health records. The downstream decisions relying on clinical NLP can be incorrectly applied, in both clinical and research settings, if word, abbreviation, and acronym ambiguity is incorrectly interpreted.

Clinical Abbreviation Resolution Engine (CARE) with Deep Sequential Learning is a deep learning method that addresses word sense disambiguation to significantly improve text information extraction from electronic medical record sources of high value, such as admission notes, consults, and discharge summaries. CARE has the potential to improve clinical NLP from an 80% accuracy rate (where it has been stalled for years) to over 95% by addressing these key additional word tokens.

### CURRENT STATUS

The research team is pursuing commercial paths for the innovative solutions that they have built in this project.

For more information, reach out to the PHDA at healthdataalliance.com/contact.

### RESEARCHERS

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## *TDI – DioneX*

**More accurate cancer diagnostics from identifying tumor driver genetic mutations**

### PROJECT SUMMARY

Precision oncology aims to treat patients based on the genomic makeup of their individual tumor. However, current methods are limited in their approach and scope. For example, immunotherapy drugs are currently used as first line treatment for many solid tumors, including melanoma, without prior genetic testing. While around 30% of patients benefit from this approach, no solution exists to select better treatments for the large group of non-responders, leading to suboptimal outcomes and higher costs. To help address this problem, DioneX has developed algorithms that can estimate disease mechanisms of individual tumors and predict the most effective, personalized treatment for each patient.

The core technology of DioneX is TDI, Tumor Driver Identification, an engine that employs causal inference modeling and data mining integration of genomic and transcriptome characterizations of individual tumors. The algorithm estimates the causal relationships between gene alterations (M) and molecular phenotypes (P) within each individual tumor. Using Bayesian causality analysis theory, a patient-specific predictive model of the individual disease mechanism is constructed. This novel approach is designed to provide oncologists with data-driven decision support that improves diagnosis and selection of individualized, targeted cancer treatments.

### CURRENT STATUS

The TDI team received follow-on funding after the completion of their PHDA project and continues research toward creating a commercial solution.

For more information, reach out to the PHDA at healthdataalliance.com/contact.

### RESEARCHERS

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## *AuguryDX*
### Neonatal circulating cell-free DNA diagnostics for silent disease progression

#### PROJECT SUMMARY

Complex human diseases and most cancers often remain undetected until they become incurable or challenging to treat. Early diagnosis is frequently impossible or dangerously invasive by current methods. Treating advanced chronic diseases and cancer consumes the majority of health expenditure. To solve these problems, AuguryDx provides a platform technology that can be used to develop non-invasive, disease specific, early tests for screening or diagnosis of a variety of diseases. The AuguryDx platform is currently being validated through proof-of-concept studies in women's health and infant diseases, with plans for developing oncology applications in the near future.

#### CURRENT STATUS

The AugruryDX research team is exploring paths to market for their technology.

For more information, reach out to the PHDA at healthdataalliance.com/contact.

#### RESEARCHERS

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## *MEDIvate*

**Solution to improve medication outcomes through consumer engagement during transitions of care**

### PROJECT SUMMARY

Preventable medication errors cost an unsustainable ~21 billion dollars annually. Consequently, healthcare spending has shifted from a fee-based model to one focused on value and cost savings. Payors rate institutions, pharmacies, and providers use quality metrics to justify payment, some of which are based on patient medication experiences. These groups are spending millions of dollars annually to prevent medication use problems through medication reconciliation tasks and education in order to improve their ratings, retain patients, and build efficiency. Patient engagement is a key aspect to achieving high quality, affordable care. The uptake of health-focused personal technology is exploding, but few products target medication outcomes, an estimated more than $161 million market.

MEDIvate is a simple-to-use, patient-centered smartphone application that empowers patients and providers to achieve great medication outcomes. Current market alternatives/barriers are costly, cumbersome, and often still paper-based. MEDIvate's approach will be successful because it makes patient medication lists up-to-date, portable, and easy to share. Current medications are added directly to the app from EHRs or by the patient, and are always accessible. Patients trigger easy sharing of their personal medication history with their healthcare providers at the point of care. This ensures accuracy to reduce medication errors and saves time to improve transitions of care. MEDIvate is also a personal medication coach. It reminds patients to take their meds and intelligently links key facts/educational videos on-demand from pharmacist experts.

### CURRENT STATUS

The MEDIvate team is continuing research and exploring use cases in multiple patient populations.

For more information, reach out to the PHDA at healthdataalliance.com/contact.

### RESEARCHERS

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## *OncoBioelectrx*
### Personalized implantable neuroengineered device for cancer treatment

### PROJECT SUMMARY

Despite the use of targeted therapies, lung cancer remains a significant problem with a 5-year survival rate of 18%, and 25% of the annual cancer deaths. Inflammation is a critical component of lung tumor progression, and maintaining immune homeostasis in lung cancer patients is critical to:

1. Decrease inflammation and enhance the therapeutic effects of chemotherapy.
2. Reduce anti-inflammatory co-therapy that causes severe side effects.
3. Reduce tumor-promoting myeloid cells and macrophages that promote tumor growth and drug resistance.

OncoBioelectrx is a drug-free, implantable immunotherapy neuromodulation device designed to stimulate anti-inflammatory pathways to achieve inflammatory homeostasis that can simultaneously repress inflammation and boost antitumor immunity.

### CURRENT STATUS

The research team is optimizing their technology on all fronts and continues to take a multidisciplinary approach.

For more information, reach out to the PHDA at healthdataalliance.com/contact.

### RESEARCHERS

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## *CADidME*
## Coronary Artery Disease Intelligent Detection via Metabolomic Expression

### PROJECT SUMMARY

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality and causes 1 in 3 deaths in the U.S. (a total of 800,000 annually). CVD has taken a disproportionate toll on many racial and ethnic groups that have higher rates of CVD and its risk factors, and CVD accounts for about one-third of the disparity in potential life-years lost between blacks and whites. A prominent example of a CVD risk factor that varies based on race and ethnicity is vulnerable atherosclerotic plaques, a major culprit for CVD events. However, patient and subtype-specific CVD risk assessment is currently lacking from clinical practice. Thus, there is a great need for tools to detect, diagnose, and stratify patients that would allow doctors to provide tailored interventions to high-risk groups.

CADidME is a risk prediction tool that characterizes CVD events according to specific subpopulation characteristics, including metabolomic data. CADidME tools will enable precision CVD diagnosis and management to reduce adverse CVD events in patients. CADidME uses comprehensive metabolomics profiles to standardize and replace multiple biomarker screening tests to benefit consumers, clinicians, and healthcare insurance through simplification and cost-effectiveness.

### CURRENT STATUS

The CADidME research team has established novel techniques for biomarker discovery and is exploring high impact applications.

For more information, reach out to the PHDA at healthdataalliance.com/contact.

### RESEARCHERS

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## *Pressure Ulcer Monitoring Platform (PUMP)*

**Hospital acquired pressure ulcer prevention monitoring platform**

### PROJECT SUMMARY

Hospital acquired pressure ulcers (HAPUs) are areas of localized skin and soft tissue destruction caused by prolonged pressure in debilitated patients. The estimated PU prevalence is 3 million patients at a cost of $3.6 billion per year. Several interventions and preventive measures are recommended to avoid hospital acquired pressure ulcers, including: patient repositioning, proper nutrition, pressure-relieving support surfaces, pneumatic mattresses, and skin care. Repositioning patients in bed is particularly a key preventative measure and a target of opportunity for low-cost innovative technology-based solutions.

Pressure Ulcer Monitoring Platform (PUMP) provides solutions for improving compliance with patient repositioning through nursing intervention solutions. It combines (1) a low-cost, but sophisticated wearable sensor that automatically detects when patients are repositioned and wirelessly records the event in the medical record, which is more suitable to patients with shorter lengths of stay, (2) a second sophisticated sensor device placed under the wheels of each hospital bed, which is more suitable for patients with longer lengths of stay or for those patients that are not suitable for a wearable device, and (3) an electronic alert system via mobile phone SMS to change nursing behavior and increase compliance. PUMP aims to minimize the operational and maintenance efforts by doctors and nurses, reduce obtrusiveness for patients, and to achieve the highest system reliability and minimal system cost.

### CURRENT STATUS

The PUMP research team completed their PHDA/CCA project and a team member went on to found Pitt spinout company eWear Technologies, which is developing wearable sensor technologies.

For more information, reach out to the PHDA at healthdataalliance.com/contact.

### RESEARCHERS

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## *Fall Sentinel*

**Multi-drug interaction analysis for fall risk reduction at skilled nursing facilities**

### PROJECT SUMMARY

Falls are the leading cause of fatal and nonfatal injuries among adults aged 65 years or more. This finding, and the aging of our nation, suggests that national attention on the problem of falls will continue to increase. Tools that can help reduce falls are badly needed in the skilled nursing facility setting, where 45-64% of the patients experience a fall each year. The mean incidence of falls is 1.7 falls per bed per year, 10-25% of which result in fracture or laceration. The market for skilled nursing facility fall prevention tools includes approximately 15,700 facilities that provide care for roughly 1.4 million residents. Treatment of falls in the nursing home is estimated to cost about $5 billion per year and can result in further litigation risks.

Fall Sentinel is an automated risk monitoring system that applies a validated patient level prediction model to determine patient fall risk based on medication administration and Minimum Dataset data.

Fall Sentinel technology functions by processing a stream of electronic clinical data to provide highly patient-specific and clinically actionable alerts to clinicians when residents transition to a state of unacceptably high risk for experiencing a fall while exposed to a potential drug interaction or other fall-associated medication weak spot.

### CURRENT STATUS

The research team completed their PHDA/CCA project and is now pursuing multiple lines of research to develop data-enabled solutions with commercial potential.

For more information, reach out to the PHDA at healthdataalliance.com/contact.

### RESEARCHERS

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