

BARRIERS TO EPILEPSY RESEARCH PROGRESS AND KEY PHILANTHROPIC OPPORTUNITIES

About 30 to 40 percent of epilepsy patients do not achieve effective seizure control with currently available therapies. Those who do achieve seizure control may experience overlooked or adverse side effects from the prescribed medication, diet, device or surgery. **The ultimate goal for the epilepsy community is to develop better therapeutics focused on holistic care, resulting in no seizures and no side effects for all patients.**

In May 2016, the Milken Institute Center for Strategic Philanthropy convened epilepsy experts to discuss the state of science relevant to epilepsy and the challenges currently impeding progress toward improved therapeutics and care. The goal of the retreat was to identify high-impact, actionable solutions where strategic philanthropic investment could accelerate progress in the epilepsy space. The experts prioritized the following as top challenges in epilepsy:

1. Inadequate precision healthcare infrastructure
2. Inefficient process for bringing new therapies to market
3. Limited resources and collaborations between preclinical and clinical researchers
4. Lack of cohesive care that addresses epilepsy associated conditions

Each challenge is discussed in detail below, along with potential philanthropic opportunities that can address these challenges and accelerate the progress of epilepsy research. Please note that the opportunities presented below are high-level representations and should be considered carefully with respect to your philanthropic goals and discussed in detail with a philanthropic advisor.

PROBLEM: INADEQUATE PRECISION HEALTHCARE INFRASTRUCTURE

Precision healthcare accounts for the individual's biological makeup and unique clinical manifestations when tailoring a course of treatment. In epilepsy, it is often unclear which of the many available therapies will have the greatest efficacy and lowest risk for adverse effects in an individual patient. This is because researchers and clinicians do not have a clear understanding of who comprises the different epilepsy subpopulations, what factors make these different populations unique, and which currently available treatments are ideal for each specific epilepsy subtype. In the current landscape, epilepsy patient data are collected by standalone initiatives that collect different information and do not integrate with one another. In addition, because most medical health record systems do not require specific terms when coding epilepsy subtypes, clinicians use different languages to describe similar conditions. For example, partial complex seizures, focal dyscognitive seizures, temporal lobe seizures, and intractable focal epilepsy might refer to the same condition under the current system. Careful definition and understanding of the biological underpinnings of epilepsy syndromes and etiologies will facilitate better therapeutic choices.

The solutions described below were identified by experts as necessary to catalyze precision health approaches in epilepsy.

SOLUTION 1: BUILD AN EPILEPSY CLINICAL DATA COMMONS PLATFORM

An epilepsy clinical data commons platform would be a centralized database for clinicians and researchers to access worldwide. This data commons would contain anonymized individual patient data such as imaging scans,

EEG recordings, genetic data, patient-reported outcomes, and general medical history. Electronic permission from patients to share such data would be incorporated into the platform. The focus would be to hone in on syndrome type, etiology, and patient response to therapy in terms of seizure control, adverse reactions, and associated conditions. Critical to this database would be the development and application of built-in analytical tools to extract and classify data meaningfully depending on the type of research being done. Such a clinical data commons would facilitate efficient data sharing and process innovation to better understand the biological and clinical profiles of the patient population.

CORRESPONDING PHILANTHROPIC OPPORTUNITIES

1. **Fund consortia focused on developing data collection and analysis standards for prospective data.** These consortia would determine which data should be collected, the data collection standards, and the analytical toolkit needed to mine the data effectively.
2. **Fund a bioinformatics infrastructure that will allow for intra-operability between epilepsy databases.** Following the outcome of the consortia above, the philanthropist could support the creation of a database platform as well as the technical personnel needed to ensure that the platform is optimally developed and utilized. This infrastructure would not only allow for data aggregation, harmonization, and standardization of multiple datasets but also consist of integrated analytical tools to facilitate effective data mining. This platform will enable new insights into disease subtype and treatment resistant features.

SOLUTION 2: CREATE LARGE-SCALE INFRASTRUCTURE TO SUPPORT BIOMARKER DISCOVERY USING PATIENT SAMPLES

A biomarker is an indicator of a certain state or phenomenon in the body. An ideal biomarker is a measurable dynamic change that can objectively assess disease progression and/or objectively track treatment efficacy in patients. In epilepsy, the only measure of disease progression is the severity and frequency of seizures, which occur episodically. Patients are often left not knowing if and when the next seizure will arrive. The availability of biomarkers that allow clinicians to assess the effectiveness of treatment and correct course when needed would dramatically transform care and outcomes for patients. In addition, biomarkers that can predict the likelihood of a patient to develop epilepsy would allow clinicians to target epilepsy prevention rather than epilepsy treatment. For a biomarker to be accepted as a true objective measure of a disease state or treatment efficacy, it must be confirmed by replicate experiments (biomarker validation) and detected in clinically relevant tests (assay development). The epilepsy field is still in the biomarker discovery stages and requires infrastructure to generate and aggregate biological samples on the scale necessary to support biomarker discovery research.

CORRESPONDING PHILANTHROPIC OPPORTUNITIES

1. **Fund an epilepsy brain tissue repository to support biomarker discovery.** Brain tissue removed from epilepsy patients that undergo neurosurgery is often discarded. This tissue is a valuable resource because it enables a variety of studies that could lead to the discovery of new biomarkers, patient subtypes, and/or therapeutic targets. The accompaniment of clinical data from the patient dramatically enhances the value of the tissue. Examples of clinical data include EEG recordings, structural scans, and genetic testing, all of which are collected at most epilepsy centers. There is an opportunity to standardize collection of brain tissues at epilepsy centers, centralize them in a biorepository, and provide access to samples and data to

researchers around the world. This repository would allow researchers to examine brain tissue along with the wealth of other information collected at an epilepsy center to identify changes in the brain that correspond to epilepsy subtype or disease severity. Philanthropists could support the centralized administrative core that would coordinate among the sites as well as the necessary storage equipment. Ideally, such a repository would be closely linked to the epilepsy clinical data commons platform described above.

2. **Enhance infrastructure at traumatic brain injury treatment centers.** Traumatic brain injury (TBI) is a risk factor for developing epilepsy. Patients with a TBI often receive continuous follow-up monitoring and treatment at TBI centers that collect baseline data through, for example, blood draws and structural scans. An infrastructure that would leverage these centers to also include EEG recordings and prospective follow-up may help to identify patients at risk for developing epilepsy as well as the course for disease progression. Overall, this type of infrastructure would support discovery of biomarkers for epilepsy.

SOLUTION 3: IMPROVE PRECISION DIAGNOSTIC TOOLS

Currently, clinicians rely on seizure diaries maintained by the patient or caregiver to assess treatment effectiveness. The user friendliness and convenience of these diaries have improved, in part because of mobile applications. However, it is still difficult to capture seizures in people who lose consciousness and therefore do not realize they are seizing. This unreliability is troubling because seizure diaries are the primary indicator of a drug's effectiveness. Improved diagnostic tools that would be able to detect seizures or assess whether a drug has reached its intended target would improve the clinician's ability to customize treatment to the individual patient.

CORRESPONDING PHILANTHROPIC OPPORTUNITIES

1. **Sponsor crowdsourcing challenges to improve seizure algorithm detection/prediction in humans.** Although seizures happen episodically, it remains difficult to predict when seizures will occur, and treatment cannot be tailored to seizure onset. The fear and uncertainty of having a seizure along with the side effects of anti-seizure medications can significantly impact a patient's quality of life. Epilepsy academicians have been developing algorithms for seizure prediction using EEG data for more than 40 years but have achieved a detection accuracy of only 65 percent. A recent 3-month crowdsourcing effort that extended the challenge to developers outside of the epilepsy field led to the design of an EEG algorithm that accurately detected seizures 84 percent of the time. Changing the culture to allow for open-sourced data and incentivizing others to join the effort accelerated the pace of research dramatically. Therefore, funding initiatives that expand upon previous crowdsourcing challenges (e.g., where EEG data is paired with wearable devices, structural scans, or medical record information) could build upon and improve existing algorithms. The ability to predict seizures would empower patients, informing them about medication timing and the need to avoid driving or other activities that place them at risk.
2. **Fund companion diagnostic tool development projects that assess an individual's response to the drug target.** Currently, there is no clinical test to determine whether an anti-seizure drug is impacting its intended molecular target. For example, there is no way to determine whether an anti-seizure medication designed to increase availability of the inhibitory GABA neurotransmitter in the brain is actually achieving this desired outcome. A diagnostic tool that compares the amount of GABA available after treatment to

control would indicate whether the drug is working on its intended molecular target (i.e., GABA). Assuming that a patient is fully adherent to the prescribed dosing regimen, these types of assays would help clinicians to determine whether a patient is not responding to treatment because the target or dose are incorrect, or because the drug is less effective in that patient because of genetics, environmental factors, co-morbidities, or other variables.

3. **Partner with industry to fund seizure-detecting device clinical trials.** Several commercial devices currently marketed as seizure alert systems have not undergone rigorous clinical testing through the FDA process. Clinicians are often reluctant to recommend their use to patients because of the uncertainty about their utility and reliability in different seizure subtypes. Although these devices have great potential, rigorous validation by FDA-sanctioned clinical trials is necessary before they will be widely embraced by the clinical community. Because the cost of conducting device trials for FDA approval can be a high barrier to biotech companies developing these devices, philanthropists could partner with industry to provide financial support for these trials.

Table 1. Summary of Potential Philanthropic Solutions to Address Inadequate Precision Healthcare Infrastructure

Potential Solutions	Corresponding Philanthropic Opportunities
Build an epilepsy clinical data commons	Fund consortia focused on developing data collection and analysis standards for prospective data
	Fund a bioinformatics infrastructure that will allow for intra-operability between epilepsy databases
Create large-scale infrastructure to support biomarker discovery using patients' biological samples	Fund an epilepsy brain tissue repository to support biomarker discovery
	Enhance infrastructure at traumatic brain injury treatment centers
Improve precision diagnostics	Sponsor crowdsourcing challenges to improve seizure algorithm detection/prediction in humans
	Fund companion diagnostic tool development projects that assess an individual's response to the drug target
	Partner with industry to fund seizure alert device clinical trials

PROBLEM: INEFFICIENT PROCESS FOR BRINGING NEW THERAPIES TO MARKET

Thirty to forty percent of the epilepsy patients lack effective treatment for seizure control despite the large number of commercially available drugs, many of which are generics. Unless a new drug can demonstrate a clinical efficacy superior to existing drugs or dramatically improve side effect profiles, it is unlikely that a patient will choose it. Given the high cost of clinical trials and competing priorities, industry is generally wary of pursuing new epilepsy medications because the chances of discovering a superior anti-seizure drug are low. Therefore, opportunities to lower the barriers to conducting clinical trials would encourage industry to invest in new epilepsy drug discovery and development.

The epilepsy field also needs a more robust and standardized preclinical trial infrastructure. Within the past few years, several molecular targets with potential therapeutic implications for epilepsy patients have been discovered. However, they were discovered through only one preclinical model (usually rodent models) and demonstrated in only one laboratory. For these types of discoveries to be translated into clinically meaningful results, the target must be validated using other models and replicated in multiple laboratories. Although this evidence is imperative to demonstrating the clinical relevance of the molecular target, researchers seldom receive federal funding to replicate and validate the work of others.

SOLUTION 1: CREATE A COORDINATED PRECLINICAL TRIAL INFRASTRUCTURE

The field is in desperate need of a robust and coordinated preclinical infrastructure that supports target and validation studies and assay development. A well-funded multicenter preclinical trial consortia would address many of the aforementioned challenges, ensuring that animal protocols are standardized, rapidly administered, and efficiently implemented throughout the consortia network.

CORRESPONDING PHILANTHROPIC OPPORTUNITIES

1. **Fund a multicenter preclinical trial consortium infrastructure.** Consortium would consist of laboratories from multiple institutions that would commit to work streams related to target verification in multiple animal models (e.g., rodent models) as well as alternative models (e.g., iPS cells or zebrafish). This infrastructure would test both new and repurposed compounds across different models in multiple labs to ensure reliability and reproducibility of potential drug targets identified in discovery stages before they enter clinical trials. Moreover, this infrastructure would ensure that animal protocols are standardized, rapidly administered, and efficiently implemented.
2. **Fund the startup costs to build an open-source library of existing compounds and the mechanisms they target.** As more is learned about the basic biology of epilepsy disorders, compounds with novel mechanisms are being considered for drug screening. The NIH/National Institute of Neurological Disorders and Stroke (NIH/NINDS) Epilepsy Therapy Screening Program (ETSP) has proposed to generate an open-source reference library of “tool” compounds that relates activity against known biological targets to activity in the program’s screening models. The goal of this effort is to determine whether these compounds (which could include drugs available for repurposing) and/or their targets show promise for further development. A philanthropist could partner with this program to support the startup costs of the platform, because funding has not been fully secured. Such an open-source library of compounds would create process efficiency and would provide preclinical proof of concept for potential promising targets

and compounds (including repurposed compounds) for further development and evaluation in clinical trials.

SOLUTION 2: IMPROVE CURRENT DRUG-SCREENING ASSAYS

Although rodent models have served as the primary basis for epilepsy drug discovery research for more than 40 years, these models are not ideal for high-throughput drug screens. Supporting initiatives that accelerate rate-limiting steps in mouse model drug platform screenings or developing, optimizing, and supporting alternative higher-throughput models would create process efficiency and expand the pipeline.

CORRESPONDING PHILANTHROPIC OPPORTUNITIES

1. **Fund a crowdsourcing challenge to develop improved algorithms for automated seizure detection in animal models.** Detecting seizures in preclinical animal models is a time-consuming process that requires continuous EEG recording and video monitoring to ensure that seizures are accurately detected. In turn, the analysis requires sufficient manpower to watch the recordings in real time and count the seizures by hand. Researchers agree that this analysis is the rate-limiting step in the drug discovery platform. If this process could be fully automated, then the drug discovery process would be streamlined and compounds would be screened for effectiveness more quickly.
2. **Support the development of innovative high-throughput drug platforms.** The epilepsy field offers few alternatives to traditional drug screening platforms. Moreover, a comprehensive review of what outcome measures would be clinically meaningful for patients (aside from a reduction of seizures) in traditional mouse models has not been performed. Currently the International League Against Epilepsy (ILAE) and with the American Epilepsy Society (AES) have developed a translational taskforce focused on recommending guidelines for the most pertinent data elements in preclinical models. Newer technologies, such as improved genome editing techniques (e.g., CRISPR/Cas9), allow for the development and expansion of potential alternatives (e.g., iPSC cells, zebrafish) to traditional rodent models and could inform a precision medicine–based drug discovery strategy. Philanthropists could support the further development of novel high-throughput drug platform models that incorporate clinical data elements as applicable. Such an initiative would encourage and incentivize new, innovative, and clinically relevant approaches to drug discovery.

SOLUTION 3: PARTNER WITH INDUSTRY TO LOWER THE HURDLE FOR INVESTMENT IN EPILEPSY CLINICAL TRIALS

Bringing a drug to market to treat any disease or disorder is time consuming, labor intensive, risky, and costly. According to a [2013 Nature Reviews Drug Discovery article](#) on epilepsy, the average success rate of an epilepsy drug moving from discovery stages to clinical trials to FDA approval is 5 percent, with an average investment of \$350 million over 10 years. Innovating clinical trials to incentivize industry investment would have a significant effect on the clinical pipeline.

1. **Support the development of a database housing clinical trial ready cohorts for epilepsy trials.**
Traditional epilepsy clinical trials that establish a new compound’s differentiation from existing therapies are time consuming and costly. The establishment of a registry for a longitudinal clinical trial cohort of well-characterized, clinical trial–ready subjects would decrease the time and expense needed to recruit high-quality patients and measure their baseline clinical characteristics. Centralized databases of epilepsy center and hospital patient data—such as baseline seizure frequency, duration, and severity and medication history—would provide a mechanism to access subjects for studies.
2. **Support the development of novel clinical trial networks testing “proof of concept” Phase II trials.** Phase II is the riskiest stage of the pipeline, with 65 percent of drugs failing to move into Phase III trials. This phase is an important tipping point in early clinical development because it provides the evidence needed for investment in larger Phase III trials, where a significant proportion (70 percent) of the total industry investment is made. Utilizing novel clinical trial designs to evaluate multiple compounds on an ongoing basis can provide an infrastructure for efficiently and cost-effectively testing proof of differentiation for new epilepsy compounds. Examples of such clinical trial designs exist already for breast cancer (ISPY-2) and Alzheimer’s disease (EPAD), which is scheduled to start in 2017. Partnering with industry to support an epilepsy clinical trial network would provide an effective, cost-effective mechanism for proof of differentiation and would contribute to de-risking pharma’s prioritization of epilepsy and investment in the necessary and costly clinical trials.

Table 2. Summary of Potential Philanthropic Solutions to Address the Inefficient Process for Bringing New Therapies to Market

Potential Solutions	Corresponding Philanthropic Opportunities
Create infrastructure for preclinical target validation	Fund a “center without walls” grant for a multicenter preclinical trial infrastructure
	Fund the startup costs to build an open-source library of existing compounds and the mechanisms they target
Improve current drug screening assays	Fund a crowdsourcing challenge to develop improved algorithms for automated seizure detection on animal models
	Support the development of innovative high- throughput drug platforms
Partner with industry to lower the hurdle for investment in epilepsy clinical trials	Support the development of a database of clinical trial–ready cohorts for epilepsy trials
	Support the development of a clinical network for “proof of concept” Phase II trials

PROBLEM: LIMITED RESOURCES AND COLLABORATIONS BETWEEN PRECLINICAL AND CLINICAL RESEARCHERS

Regardless of the type of preclinical epilepsy research being analyzed, it must translate to clinically meaningful information in order to benefit patients. The challenge here is that basic scientists and clinicians often have limited

interaction and work in siloes, which creates a misalignment of priorities between these two communities and hinders effective translation of preclinical research.

Moreover, funding for young investigators is limited, which leaves little incentive for new investigators to remain in the field. In addition to maintaining the current workforce of epilepsy researchers, there is a need to attract scientists from other disease areas and disciplines (e.g., engineering, computer science) to cultivate new ideas and fresh research agendas. For example, attracting engineers and computer scientists to work on improving seizure detection algorithms and database interoperability could accelerate progress in these areas and have a dramatic effect on other areas of epilepsy research.

SOLUTION 1: INVEST IN HUMAN CAPITAL

Providing support for early-stage investigators and attracting new investigators to the epilepsy field will ensure that the workforce continues to grow, providing stability to the research pipeline.

CORRESPONDING PHILANTHROPIC OPPORTUNITIES

1. **Fund additional programs that invest in predoctoral researchers, postdoctoral fellows, and early-stage investigators.** Grants to provide fellowship stipends or bridge funding would encourage young researchers to remain in the epilepsy field. In addition, to meet the need for computer scientists and engineers, funding for specific training programs would encourage these experts to enter the epilepsy field.

SOLUTION 2: PROMOTE COLLABORATIONS

Facilitating consortia or conferences for different sectors of academia, clinical care, patients, and industry to come together would ensure that the research and development pipeline aligns with patient needs.

CORRESPONDING PHILANTHROPIC OPPORTUNITIES

1. **Fund an annual conference that brings together basic science researchers, clinicians, and patients.** An annual conference that brings together these stakeholders to discuss the epilepsy field's needs and to help focus the epilepsy community on the assays that are lacking in the space would streamline the preclinical to clinical initiatives.
2. **Provide grants for small epilepsy foundations to host scientific conferences that would ensure cross-talk between researchers and communities.** There are many foundations representing specific epilepsy subtypes. Although these foundations have strong ties to their respective patient communities, they often lack financial support. A grant mechanism that provides funds to foundations to convene researchers and patients to identify the key needs unique to the subpopulation could uncover new considerations for treatment and assay development that could be applicable to other epilepsy subtypes.

Table 3. Summary of Potential Philanthropic Solutions to Address the Limited Resources and Collaborations Among Stakeholders

Potential Solutions	Corresponding Philanthropic Opportunities
Invest in human capital	Fund additional training programs that invest in postdoctoral fellows and early-stage investigators
Promote collaborations	Fund an annual conference that brings together basic science researchers and clinicians together
	Provide grants for small epilepsy foundations to host scientific conferences that encourage cross-talk between researchers and communities

PROBLEM: LACK OF COHESIVE CARE TO ADDRESS EPILEPSY-ASSOCIATED CONDITIONS

Seizures are one symptom of epilepsy. Other associated conditions include intellectual disabilities, mood disorders, and sleep disorders. Epilepsy centers are accredited centers with coordinated teams that provide high-quality comprehensive care to epilepsy patients. These care teams consist of various specialists such as epileptologists, neurologists, neurosurgeons, neuroradiologists, genetic counselors, psychologists, psychiatrists, social workers, and dieticians. Epilepsy centers specialize in defining epilepsy subtype, which facilitates the selection of the most efficacious treatment plan. Moreover, epilepsy centers provide patients with the opportunity to participate in novel clinical trials. Because of all of these advantages, it is recommended practice to refer a patient who has failed two or more anti-seizure medications to an epilepsy center.

The requirements to sustain and support epilepsy centers can be stratified by country type:

- *Countries with epilepsy centers that are either under-utilized or could be supplemented with additional support:* Although the care teams at epilepsy centers are extensive, there are opportunities to maintain support for psychologists or social workers to help patients manage the mental health disorders associated with epilepsy and other challenges related to quality of life. Mental healthcare specialists are important because epilepsy has a strong established bi-directional relationship with depression and anxiety. However, the behavioral programs at epilepsy centers often struggle to find financial support, and therefore these specialists cannot specialize in epilepsy patient care. Moreover, less than 1 percent of epilepsy patients in the United States are referred to these centers by primary care physicians and general neurologists. Often doctors outside of the epilepsy field view these centers as primarily surgical centers, therefore not realizing that they also provide holistic care. Awareness and culture change are necessary to ensure that patients are referred to epilepsy centers as soon as possible to avoid misdiagnosis and/or a delay in administration of the most appropriate treatment
- *Countries with the medical expertise necessary to facilitate an epilepsy center but no centers within their borders:* These are often middle-income countries that have trained doctors and the basic equipment to provide care but insufficient resources to build a specialty center.
- *Countries without the professional staff and equipment required to provide minimal epilepsy care:* These are often low-income countries where telemedicine may be optimized to connect the primary care providers to international epilepsy centers for support and guidance.

SOLUTION 1: PROMOTE EPILEPSY HEALTH LITERACY AMONG THE PATIENT AND MEDICAL COMMUNITY

The goal of epilepsy centers is not to remove the primary care physician or home neurologist from the patient's care, but to partner with them to offer the best therapy to the patient. In many cases, medical professionals outside of the epilepsy field are unaware of the extent of services that epilepsy centers can provide. This issue is often resolved by educating the patient and medical communities through education campaigns.

Even when patients are referred to epilepsy centers, they can encounter logistical barriers to care such as a lack of transportation. Therefore, the opportunity exists to provide support for tele-clinics during which primary care physicians present their cases, through videoconferencing, to specialists who provide advice and clinical mentoring. This model could be expanded to countries that lack basic epilepsy care.

CORRESPONDING PHILANTHROPIC SOLUTIONS

1. **Fund an educational campaign that educates patients and medical communities about epilepsy centers.** This investment would significantly affect the quality of care that patients receive. Often doctors outside of the epilepsy field do not realize that epilepsy centers provide holistic care to the patients. An additional campaign could focus on the signs or symptoms of epilepsy that are frequently misdiagnosed or result in a delay to diagnosis.
2. **Fund a pilot tele-health epilepsy program to increase patients' access to specialty care.** This investment would address three barriers: (1) insufficient provider knowledge about appropriate epilepsy treatment; (2) transportation issues for people with epilepsy; and (3) high costs that prevent patients from obtaining care at epilepsy centers. Programs could expand upon Project ECHO (Extension for Community Healthcare Outcomes) an evidence-based model that hosts weekly tele-clinics for primary care physicians to present their patient cases to epilepsy specialists using case-based learning and video-conferencing. These interactions promote adherence to best practices, thereby reducing the variation in care. New Mexico has launched an ECHO clinic model for epilepsy care to reach underserved rural areas. This tele-clinic model could be piloted in other areas of the U.S. without epilepsy centers or specialists, as well as underserved areas abroad. Funding would be directed toward supporting a regional ECHO epilepsy clinic hub, as well as assessing the overall implementation, effectiveness, and quality of the program.

SOLUTION 2: SUPPORT EXTENSION OF STAFF AT EPILEPSY CENTERS

Ensuring that there is at least one epilepsy center per country and that each center is staffed adequately to address all patient needs, not just the seizure symptoms, will enhance the quality of care for epilepsy patients.

CORRESPONDING PHILANTHROPIC SOLUTIONS

1. **Fund international subsidies to build epilepsy centers in countries that have none within their borders.** Some countries have the professional expertise but lack the necessary equipment and infrastructure to establish a centralized specialty center for care. A philanthropist could fund grants for countries to establish such a center, promoting international access to quality epilepsy care.
2. **Fund "safety-net" subsidies for epilepsy centers to support a psychologist's or clinical social worker's salary.** Epilepsy centers often do not have the resources to hire a full-time dedicated psychologist or

clinical social worker. A philanthropist could fund grants to epilepsy centers requesting 1-year salary support for a psychologist or social worker. This approach would allow epilepsy centers to have extended staff nationwide.

Table 4. Summary of Potential Philanthropic Solutions to Address the Lack of Cohesive Care for Epilepsy-Associated Conditions

Potential Solutions	Corresponding Philanthropic Opportunities
Promote epilepsy health literacy among the patient and medical community	Fund an educational campaign that educates patients and the medical community about epilepsy centers
	Fund a pilot tele-health epilepsy program to increase patients’ access to specialty care
Support extension of staff at epilepsy centers	Fund international subsidies to build epilepsy centers in countries that have none within their borders
	Fund “safety-net” subsidies for epilepsy centers to support a psychologist’s or clinical social worker’s annual salary

OTHER INITIATIVES

Payer issues are not discussed above. As the ecosystem for epilepsy treatment changes, questions about reimbursement will arise. Specifically, if a preventative epilepsy treatment becomes available, how will health insurance companies cover the cost? In the area of value and coverage, philanthropists have limited opportunities to participate. However, potential consortia could be funded to encourage the various stakeholders such as government and industry to discuss what the future issues and opportunities.

SUMMARY

The proposals described above could greatly improve the field of epilepsy research. The Epilepsy Scientific Advisory Group identified the following proposals as the major inflection points for philanthropic support:

- **Build an epilepsy clinical data commons platform.** An overarching theme throughout the retreat was the lack of information that the epilepsy field has about its patients. Clinicians do not know with 100 percent certainty the frequency, type, intensity, timing, and precipitating factors of their patients’ seizures. A platform that collects these data and provides the appropriate analytical tools would improve a clinician’s ability to rapidly diagnose, facilitate patient stratification to get patients to their therapeutic endpoints quicker, and promote drug discovery. Such a database would also accelerate biomarker discovery and precision diagnostics through the process efficiency resulting from such a platform.
- **Invest in young investigators.** Young investigators are essential to the system’s sustainability. The field’s ability to move forward will be greatly limited if it cannot recruit and retain investigators.
- **Promote collaborations through funding conferences that bring together basic science researchers, clinicians, and patients to discuss key unmet needs.** The assays developed must be clinically meaningful. Therefore clinicians and preclinical researchers must talk to each other to ensure that drug discovery platforms and diagnostic assays are useful. Also important to this conversation is the patient, who could provide input on what should be prioritized. A small capital investment in annual conferences where

stakeholders meet in person to discuss current discoveries and unmet needs would ensure that their missions are aligned.

- **Support communication campaigns and tele-health regional hubs to increase access to quality care.** Epilepsy centers are designed to provide cohesive holistic care to the epilepsy patient. Referring patients to these centers faster, or using these centers to guide and mentor primary care providers, would dramatically enhance quality of care for patients.