

On a Technology-Enabled Collision Course: Clinical Research and Clinical Practice Converge through Real World Evidence



Contents

Introduction	4
An Enhanced Approach to Trial and Study Planning Along With Recruitment	6
Emerging Research Applications	8
Creating an RWE Technology Platform to Harness and Deliver Value	10
1. Critical Capabilities of High Performing Systems	10
Case Studies: The Power of a Statistical Computing Environment	13
1. Comparative Effectiveness Analyses	13
2. Performing Commercial Analytics	13
3. Natural Language Processing	13
4. Integrated Clinical/Claims Registries	13
Factors that Determine Success	14
Conclusion	15
Contributors	16

Introduction

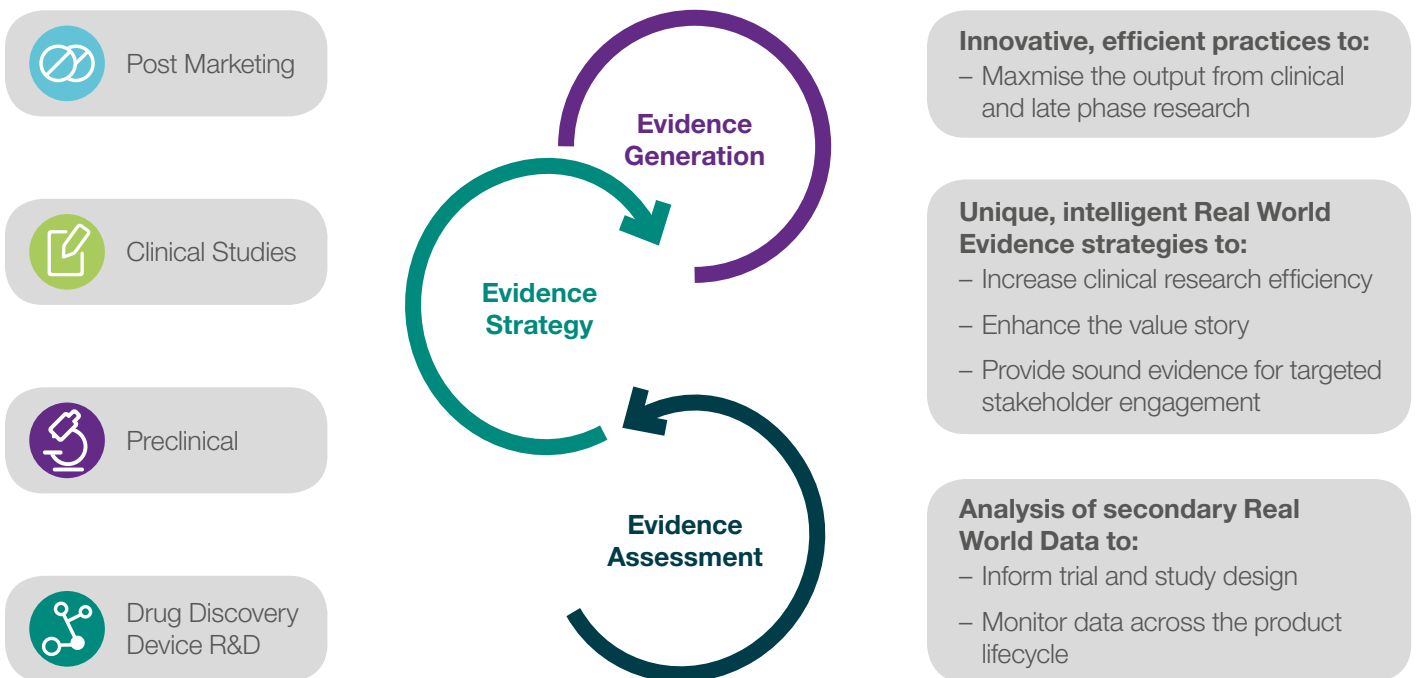
Late Phase Research in the Life Sciences segment is undergoing a rapid transformation due to the digitalisation of healthcare and the greater availability of, and access to, Real World Data (RWD). This transformation is arriving not a moment too soon, given the changes anticipated from the Twenty-first Century Cures Act, EMA's Adaptive Pathways approach, and the increased demand for Real World Evidence (RWE) generated from these RWD. In addition to supporting regulatory decisions, RWE is playing an ever expanding role in developing the product value propositions that are driving reimbursement decisions globally.

Within the broader healthcare ecosystem today, there is an electronic infrastructure largely in place that is leading clinical research and clinical practice to converge around the patient's electronic health record. This is having a profound effect on how Real World Late Phase Research (RWLPR) is conducted. Technology, too, is playing a critical role by making RWD more readily available for RWLPR needs as well as for the deep analytics that underpin more informed decisions in clinical research efficiency and other applications. Here we present the case for expanding the use of RWD and technology to deliver value across the Life Science enterprise, with special emphasis on RWLPR.

To remain competitive, sponsors must consider how they can more completely leverage RWE across the enterprise for maximum value. This involves taking full advantage of the technology innovations that allow for collecting, standardising, and analysing RWD assets even faster. In order to maximise their potential for both clinical and commercial success, sponsors must take three crucial steps: assess their evidence needs, develop an evidence strategy, and then generate evidence. (See Figure 1.)

Figure 1: Real World Intelligence™ to Drive RWE Generation

Maximising Real World Data across the drug & device development and commercialisation continuum. Leveraging Real World Data increases the potential for clinical and commercial success.



There has never been much doubt about the potential value of RWD assets, such as electronic health records, medical claims, biosensors, wearables, and mobile apps, for a biopharmaceutical, medical device or diagnostic research company. The doubt has come from how that potential value can be realised. RWD captured during, or as a byproduct of, routine clinical care can provide a trove of insights that will improve the efficiency of the drug development cycle. Applications that have tantalised sponsor companies as possible game changers range from streamlining clinical trial recruitment, to supporting regulatory filings, to expanding patient access, to conducting drug safety surveillance.

However, the ability to realise the full potential of RWD has eluded companies to date, as privacy laws, technical complications, and evolving regulations have all hindered access and the speed with which RWD can be put to use. Today, many of the hurdles to benefiting from these data have been overcome; RWD are driving greater efficiency in clinical research through better trial planning as well as challenging dated observational research models.

With the right technology infrastructure and support, RWD can now be collected, stored, analysed, and reported on, bringing the benefits of RWE to clinical research and also commercialisation decision making. With emerging applications for trial planning and patient recruitment, RWD are enhancing the efficiency of these activities today, while also setting up a foundation for data collection during the execution phase of the study. Looking at RWE generated for targeted planning and recruitment activities is where we begin.

RWD Source Domains

Any technology platform designed to capture, store and manage EHR data must be able to accommodate three basic types of data sources:



Structured Data Sources

- EHR
- Medical Claims
- Clinical Intergrated networks (such as PCORI)
- Registries
- Commerical vendors



Semi-Structured Sources

- Administrative data (e-consent, study-specific master data, audit-specific data)
- Post-trial patient datasets (observational study data)
- Patient-reported data




Unstructured Sources

- Medical device data
- Consumer device data
- Others (social media, patient surveys)


An Enhanced Approach to Trial and Study Planning Along With Recruitment

The enrolment process for clinical trials is notoriously inefficient, consuming up to 40 percent of the industry’s clinical trial budget¹. Sponsors typically struggle to identify the best investigator sites and enrol the target number of patients amid competing trials and low participation rates. According to the Tufts Centre for the Study of Drug Development, most study timelines need to be doubled from their original estimate in order to meet patient recruitment goals, as over one-third of sites under-enrol².

While some progress has been made in the investigator selection process, a good bit of the inefficiency attributed to enrolment stems from the traditional recruitment model of relying on selected Key Opinion Leaders (KOLs) to recruit patients. By leveraging the right intelligence about how many patients are eligible—and where they are—this model can be turned on its head. RWD can improve this process dramatically in three ways :

 – **Protocol Feasibility Assessment**
EHR data can be used to estimate the size of the available patient population, given a trial’s specific inclusion/exclusion (I/E) criteria. What’s more, it can demonstrate the impact on patient counts based on adjustments to specific inclusion and exclusion criteria.

In this way, sponsors can make minor adjustments to the protocol in order to yield the best recruitment rates. For instance, an analysis of EHR can reveal what effect requiring a hemoglobin A1C level of 6.5 vs. 7.5 would have on eligible patient counts for a chronic kidney disease trial, providing real options in assessment of optimal I/E criteria to meet study endpoints. (See Figures 2 and 3.)

 – **Site/Physician Identification**
Once the trial’s Inclusion/Exclusion (I/E) criteria have been defined, they can be applied against de-identified patient data from providers’ EHR systems to determine eligible patient counts by provider. With this insight, sponsors can proceed more strategically with a well-informed recruitment model, focusing on those sites that are serving a patient population that aligns with the protocol criteria.


 – **Patient Identification**
Once the trial’s I/E criteria are built into the appropriate providers’ EHR networks, the software can then be programmed to alert physicians to suitable patients within their practices. The provider can engage these prospective participants and, if they are interested, consent and enrol them into the trial. Proactively identifying potentially eligible patients in this way has been deemed as meeting Meaningful Use standards for EHR in the US³.

Figure 2: Patient Attrition Funnel Using EHR Data

Figure 2 shows the effect on the number of eligible patients as inclusion and exclusion criteria are applied in the EHR system. The resulting 17,630 patients can then be plotted on a heat map to focus site selection and patient recruitment efforts in areas with high concentrations of eligible patients.

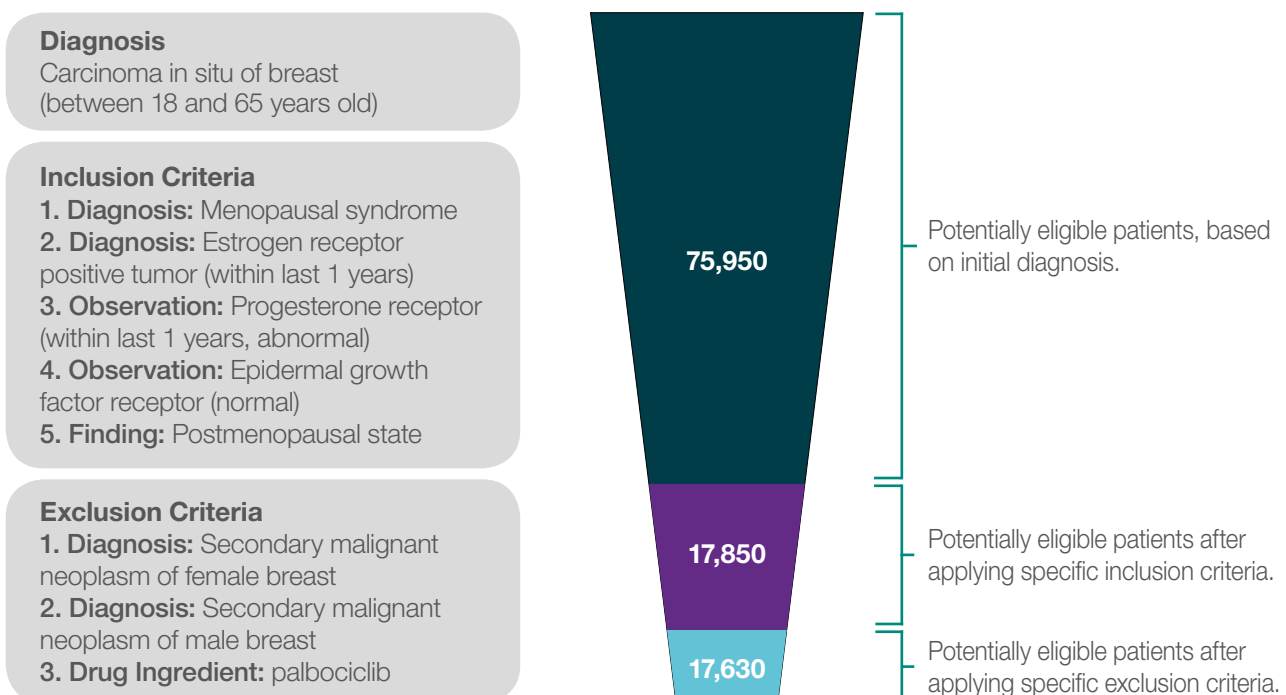
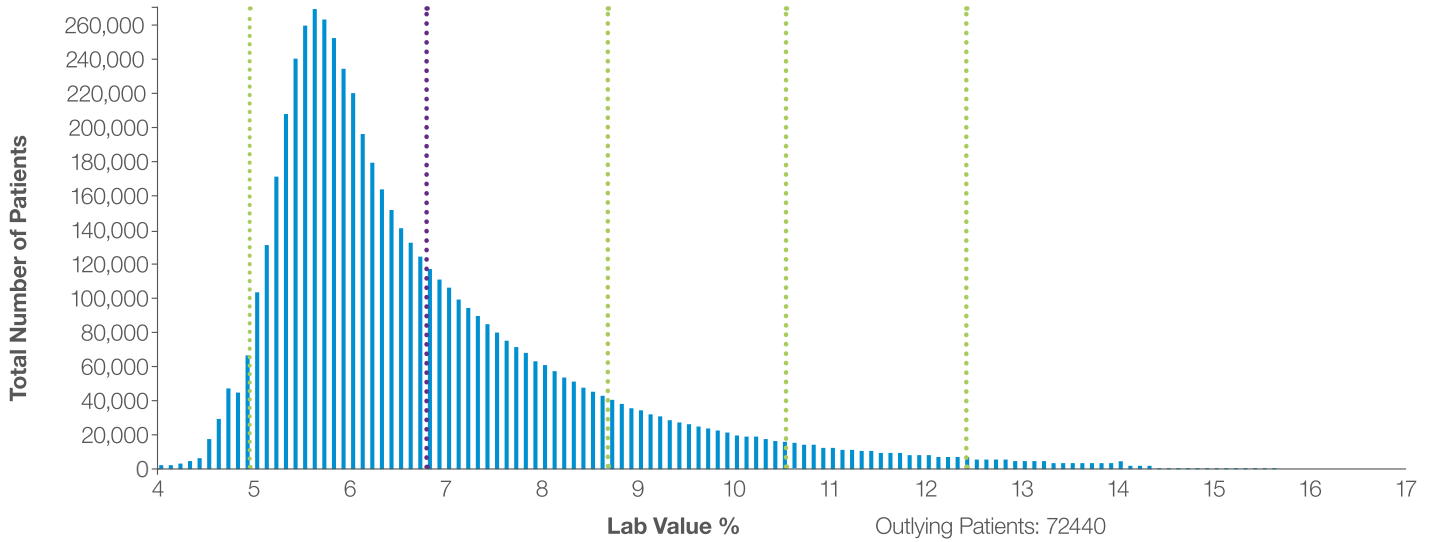


Figure 3: Effect of HbA1c Requirement of >6.5% vs. ≥7.5% on Patient Availability

Hemoglobin A1c/Hemoglobin total in blood

TNX:LAB:9037 contains LOINC codes



	Min	Max	Median	Mean (μ)	Std. Deviation
Network Stats (18-65years/any g)	0.0	22.0	6.20	6.80	1.87

Figure 3 shows an HbA1c sensitivity analysis done to help a pharmaceutical sponsor decide whether to move the lower range of eligibility from 7.5 to 6.5. The analysis, run at both 6.5 and 7.5, revealed that only 30 more patients in that specific cohort would match the criteria if the HbA1c threshold was changed to 6.5. Since there were already over 8,000 matching patients in the cohort, the recommendation was to keep the study entry criterion at 7.5. This HbA1c distribution chart is for the full EHR data set and not for the specific cohort of patients in this sensitivity analysis.

These assessment tools deliver an enhanced approach to trial planning and recruitment through targeted analyses of how I/E criteria will shape a potential patient study population, increase patient identification efficiency, with both leading to less reliance on traditional models that extend timelines and ultimately delay the delivery of study results. This application of RWE can offer significant trial planning advantages and is just one of many benefits that an overarching technology-enabled solution brings to the enterprise.

Emerging Research Applications

While RWE, technology, and analytics solutions are making inroads to improve patient enrolment speed and efficiency, robust technology platforms coupled with greater access to RWD are now reshaping the observational research landscape at an accelerated pace. Traditionally, prospective observational studies to measure care utilisation, disease incidence/prevalence, and risk factors have been conducted on patients who are formally consented and enrolled into a registry. Similar to the start-up process for a randomised clinical trial (RCT), registries require some up-front work on the part of providers, as patients who are suitable for inclusion must be identified, consented, and enrolled. The expenses associated with enrolling patients, compensating providers, and following patients over several years can amount to millions of dollars each year.

The availability of RWD, driven by the high degree of EHR adoption, presents an alternative approach to observational research and is suitable for prospective, retrospective, and hybrid studies. Table 1 shows the broader set of applications and highlights the benefits of a technology-enabled approach.

As seen in Table 1, for each application, identifying what RWD already exists that can supplement or drive a study forward can also deliver greater overall efficiency in the research study. For example, most patients who participate in Phase III trials are lost to follow up once the trial closes since their physician is no longer entering data into case report forms (CRFs) in the trial's electronic data capture (EDC) system. Now, however, it is possible to continue following trial participants even after their last trial-related visit because the physician's system can continue coding patients' health records against the same unique identifier used in the clinical trial. It can all happen seamlessly, without intervention and without any extra data entry on the physician's part.

While it is not inexpensive to map multiple EHRs to an integrated database, this approach allows data to be collected for extended periods of time on a large number of patients, with little burden on sites, physicians, and patients. Such a course of study is particularly appropriate following any pivotal trial that used a surrogate endpoint for a long-term outcome such as overall survival (OS) or progression-free survival (PFS). In the case of retrospective studies, availability of over 15 years of EHR historical data means no wait time to follow patients through their disease trajectory, while allowing researchers to analyse data that have already been collected. The benefit from using EHR systems instead of doing a retrospective chart review comes in time saved and ease of data identification and analyses.

Enhancing feasibility and patient recruitment through RWD analyses, as well as using readily accessible RWD for emerging research applications, are just the first steps in fully leveraging technology to generate meaningful and impactful RWE. While a number of analytic tools exist that can be layered over a single, large data set, a robust RWE technology platform is able to aggregate large, disparate data sets into a common data model and provide analytics to support the entire clinical and commercial continuum. While the diversity and efficiency of using RWD to positively influence clinical research is clear, understanding how these applications can best be leveraged within a cohesive RWE strategy is best explored through a fit for purpose, comprehensive technology platform.



Comparison of Traditional and RWD- and Technology-enabled Approaches to Research

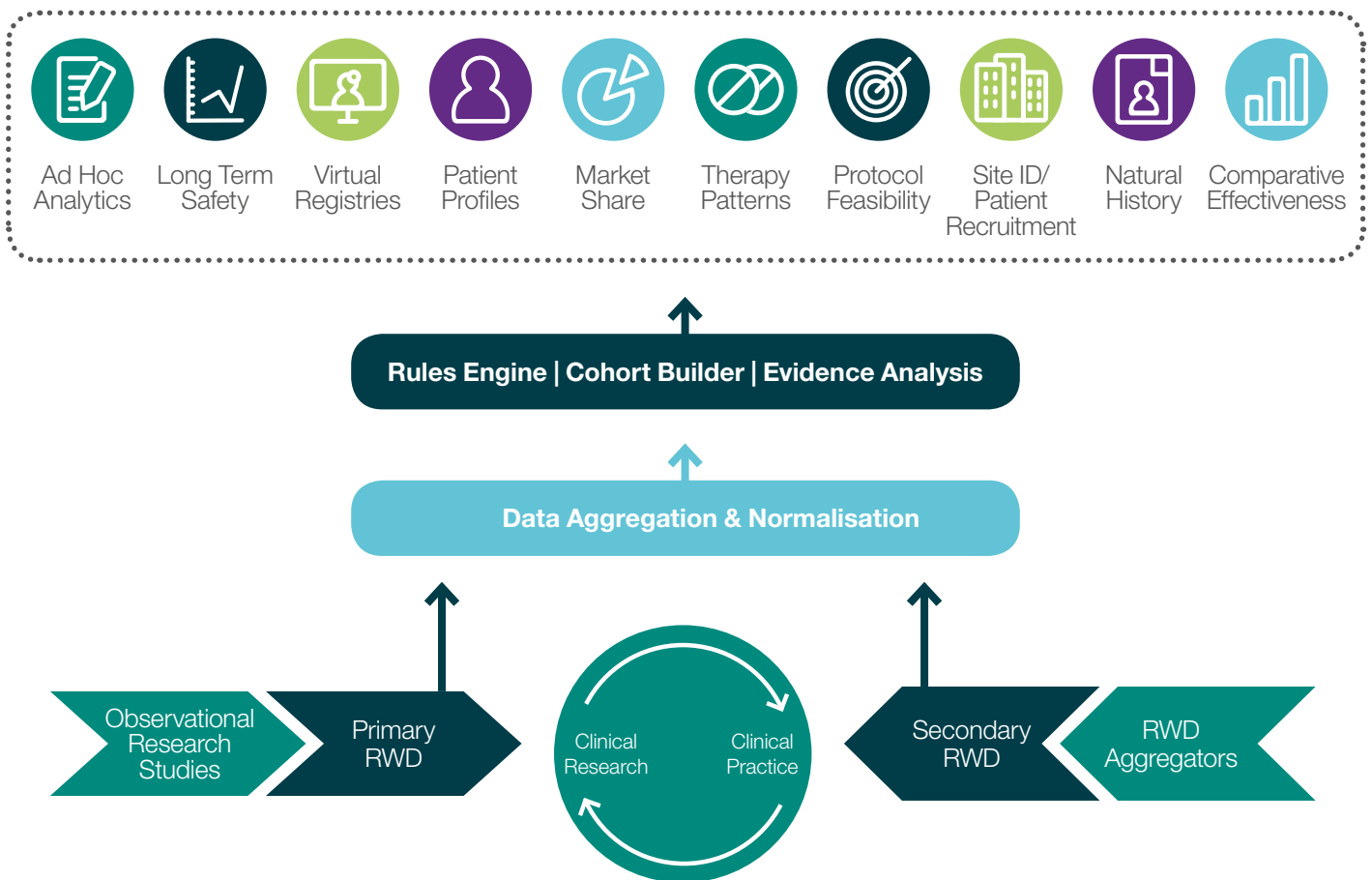
Application	Traditional Approaches Include Similar Steps Across All Applications	RWD and Technology-Enabled Approach
Retrospective epidemiological studies	<ul style="list-style-type: none"> – Retrospective chart review – Physician identifies, consents and enrolls patients as part of routine care process – Data are captured in a standardised database for several years 	<p>Approximately 15 years of EHR data collection provides breadth of data that can be leveraged to:</p> <ul style="list-style-type: none"> – Understand the progression of disease and treatment pathways – Characterise a disease – Estimate input parameters for studies of disease transmission – Support calculations of disease burden – Prospective studies
Prospective studies	<p>↓</p> <p>“</p>	<ul style="list-style-type: none"> – EHR data collected on patients exposed to a given treatment to compare safety and efficacy before and after treatment – Analysed at the de-identified patient level, then aggregated so that results can be generalised to a population
Phase IV hybrid studies	<p>↓</p> <p>“</p>	<ul style="list-style-type: none"> – Retrospective analysis of a site's EHR provides baseline data – Subset of those patients are enrolled in a Phase IV study at that site – Data entered into EHR at routine visits, which is linked to the EDC – CRF auto-populated saving physician from double entry
Long term, post-authorisation safety studies (PASS)	<p>↓</p> <p>“</p>	<ul style="list-style-type: none"> – Continue following trial participants after their last trial-related visit – Physician continues coding patients' health records against the same unique identifier used in the clinical trial
Registries	<p>↓</p> <p>“</p>	<ul style="list-style-type: none"> – Integrated EHR Registry: – Combine data entered in to the EHR system, including PROs, with claims data to get a broad picture of the patient – Virtual registry with Data Linkage – A fully EHR-driven registry that can automatically include a patient who fits the criteria in near real-time – Allows for direct communication with providers and collection of enhanced assessment data in usual care for subset of patients

Creating Synergy – An RWE Technology Platform to Harness and Deliver Value

Creating a powerful RWE strategy demands a focus on organising and synthesising the many RWD asset options that are available to Life Science companies. A fit-for-purpose RWE technology platform serves as the foundation upon which to deliver maximum value from the aggregation of RWD sources—both from across the enterprise as well from primary RWD, such as registries and other types of prospective observation studies.

With big data solutions advancing to the forefront of the healthcare ecosystem, companies must build—or have access to—a technology platform capable of generating a continuum of insights from EHR and other RWD sources. The right platform will maximise the return on a company’s investment in both the technology and RWD assets, supporting ad hoc analytics, long-term safety studies, virtual registries, as well as many others as shown in Figure 4.

Figure 4: The Framework for Maximising the Value of RWD



At a high level, an RWE technology platform consists of components for consuming, storing, aggregating and processing the data, and bringing multiple input feeds

together into a “transactional data store” that offers a single source of the truth, to which tools are then applied for analysing the RWD and visualising the outputs. (See Figure 5.)

Figure 5: Conceptual Infrastructure of an RWE Technology Platform



1. Data Consumption

Receives structured and unstructured varied EMR data from sites.

Data is consumed over multiple channels including REST/Http(s), FTP.



2. Data Hub

Infrastructure to receive, store and aggregate clinical data.



3. Data Processing

Process raw data stored in data hub and populate operational data store as per to be determined structure definitions.

Data normalisation pipelines applied to standardise structured and unstructured data into clinical data elements for CRF population. Includes NLP & CMOP transformation.



4. Operational Data Store

Single source of truth, transactional data store, bringing together multiple input feeds into a single view.

Offers Client access to raw data.



5. Analytics

Ad-hoc and packaged analytics for treatment patterns.

Offers site physicians an analytics dashboard with reports from collected study data.

Critical Capabilities of a High Performing System

RWD platforms have become more effective in that they can process RWD faster and transform RWD into valuable real world evidence more efficiently. This allows researchers to more quickly gather and take action on insights. Let's take a look at some of the critical capabilities of high performance platforms.

Cohort Management

The system must allow users to define patient cohorts/subpopulations based on their demographics, diagnoses, procedures, lab results, medications, etc. Easy cohort development requires configurable rule authoring. As seen in the trial planning and recruitment section, being able to assess potential patient cohort size by these data can aid in trial planning decisions. If this data is housed and managed in a larger platform, then connectivity between the cohort and the RWD that is available for the patients in the cohort becomes much more valuable.

Ability to Receive, Secure and Store Diverse Datasets

EHR datasets are among the many RWD sources that are fueling the growth of “big data.” Within the healthcare ecosystem, a single study has the potential to reach 100 data assets, each with millions of patient records. These large, heterogeneous data sets derived from various source systems must be received, stored, and managed in a scalable data hub. The incoming data will be in various forms (from structured to unstructured⁴), across multiple protocols, and transmitted at different velocities.

Data Aggregation

Today, the majority of EHR data sets follow a common data model established by the Observational Medical Outcomes Partnership (OMOP), and most data vendors have the necessary Extract, Transform, and Load (ETL) routines to deliver their data in the common OMOP data model. Incoming data in the OMOP model can be warehoused and analysed as a pooled data set. The RWE platform must be based on such an industry standard data model such that it can store clinical data, data from wearables and sensors, PROs, ClinROs, as well as administrative claims data. This will give users the ability to reconcile clinical and claims data to define a robust patient health record longitudinally.

Natural Language Processing

Much valuable information within the patient's record — such as the physician's observations, comments on radiographic images, PROs and general visit notes — exist as free text entries that cannot be captured by templates, check boxes, and drop-down menus. Therefore, the system should be capable of extracting free text from EHRs. Free text must then be mapped via a natural-language processing algorithm to a controlled vocabulary that is semantically equivalent to what is in the free text. Only when free text is converted to such a controlled vocabulary can it be tabulated and summarised statistically.

Data De-Identification/Enrichment

Although most data sources only provide de-identified data, the system must incorporate algorithms for de-identifying and enriching data. Patient data must be de-identified before it enters the data hub, with unique patient codes assigned to each patient to support longitudinal analyses.

Ability to Receive Streaming Data

The data hub should be able to process data streaming in from a variety of devices (such as mobile phones, wearables, shareables, and the Internet of Things (IoT) and store it against patients according to their unique identifiers. Apps downloaded to smart phones provide an alternative to collecting Patient-Reported Outcomes (PROs) via surveys or diaries—especially for studies requiring regular measurement over short periods of time. Smart phone sensors present an opportunity to collect novel, objective health outcome measures in prospective studies, as they can provide data on large populations without the need to supply wearables or other devices. And, personal health kiosks that subjects use to track their own health outcomes offer an increasingly viable opportunity to collect objective outcomes measures in observational and RWE studies. These data can be integrated with patients' longitudinal health records for a more comprehensive view of their health.

Late—or no—Binding

Flexibility must be built into the system such that data or scenarios (i.e., new business rules and terminology changes) can be changed at any time. The system must allow data to be captured in the present for future analysis and allow data to be reprocessed under new business rules. This ensures that the platform is able to grow and morph overtime as new business needs or requirements present themselves.

Privacy and Security

The system must be compliant with industry standards, to include HIPAA privacy rules and 21 CFR in the US, and the EU Data Protection Directive in the EU. Protocols should include encryption, authentication, and access restrictions.

The HIPAA privacy rule governs the use and disclosure of Protected Health Information (PHI), with the fundamental principle being that individuals have the right to decide how their personally identifiable information be used. Thus, as “covered entities,” those who access EHR data acquired from sites and vendors must first specify how the data will be used and limit its use accordingly. In such databases, patients cannot be identified (except with their express permission), although physicians may be.

In the EU, where the Data Protection Directive is generally more restrictive, even individual physicians cannot be identified in RWD sets without their permission. And, users of an RWD platform must apply for permission prior to querying the system with each research question. It is critical that a RWE platform with these functionalities be used in order to transform the data in a way that provides support for a broad array of use cases across the enterprise. With these capabilities in place, once the data is aggregated, standardised and ready for in depth analytics, the platform can then deliver on the desired RWE generation strategy.

Case Studies: The Power of a Statistical Computing Environment

All of the above functions are pre-requisites for making use of advanced analytical tools that shorten time to insights. Ideally, the platform infrastructure would include pre-packaged analyses such as clinical/financial/utilisation measures, re-admission algorithms, and patient-risk stratification, but it is important to have the ability to customise and shape the reporting outputs to meet functional specific objectives.

Powerful platforms have been designed for end users in life sciences companies to leverage real world data in the following ways. With the right analytics approach, life science companies can also see additional value through key healthcare measures from the perspectives of other important stakeholders including providers and payers, for example:

Comparative Effectiveness Analyses

A US based pharmaceutical company wished to compare the cost and benefits of its drug against competing products. The specific research objective was to identify patient cohorts based on drug usage and then to compare the cohorts based on clinical outcomes. Through a combination of pre-built business intelligence components and customised tools, the company was able to use its platform to:

- Link and store RWD from disparate sources into a common data model
- Configure more than 80 patient markers for statistical mining
- Build patient cohorts based on user-defined parameters
- Compare multiple treatments based on various patient characteristics

Performing Commercial Analytics

One developer of data-driven business solutions for pharmaceutical and biotech companies needed to offer its clients the ability to report on prescription and patient volumes, analyse competition and patient distribution, and perform forecasting and predictive analyses. The business intelligence solution presented rich insights in the form of customisable visualisations to:

- Compare the success of a drug vs. its competitors
- Monitor which physicians were prescribing which drugs
- Track improvements in sales due to specific initiatives

Natural Language Processing⁵

A US based drug manufacturer wanted to analyse information about its drugs in clinical notes using Natural Language Processing (NLP) for its Pharmacovigilance Initiative. An automated solution was built to analyse the data to identify if patients were currently on any anti-epileptic drugs for controlling seizures, and to recognise reasons for discontinuation. The solution included,

- Consolidating the understanding of NLP core concepts with libraries associated with Apache cTAKES, Apache OpenNLP and UIMA framework
- Identification of language semantics and patterns for NLP training data
- Identification of algorithm and cTAKES modules to achieve expected outcome - chunking and stemming, UMLS and dictionary lookup, relation extractor and negation detection

Integrated Clinical/Claims Registries⁶

The client is a Community Care & Informatics organisation that provides population management and care coordination services to community hospitals, serving over 24,000 providers and covering over 13 million patients along the East coast. The client wanted to establish disease-specific registries to help participating providers identify at-risk populations. The solution included:

- Data Aggregation and standardisation:
 - Patient health data aggregated from multiple sources like Medicaid Claims, In-patient, out-patient etc.
 - Normalisation of aggregated data by linking patient records through custom MPI
- Disease specific Clinical Registries:
 - Building diabetes, hypertension, asthma, heart failure and paediatric preventive care registries
 - Identifying patients who were non-compliant for certain clinical quality measures based on definitions from NQF, NCQA, CMS, etc.

Factors that Determine Success

The use of RWD in clinical applications is new enough that few life sciences companies have established their own technology platforms and the operational support required to perform the applications discussed above. To be successful in developing an RWE capability for clinical and commercialisation applications, sponsors should bear the following points in mind:

- **Be certain the data sources of interest include the right data elements.**

Review both structured and unstructured data elements to confirm that the necessary information exists in the source data. This requires the help of specialists who can make sense of disparate data sets and who have a clear vision of what can be done with them.

- **Work with partners who are ‘data agnostic’**

The most robust systems will draw on data from multiple sources/vendors. Any development partner should be willing and able to work with data from multiple and various sources, without any conflicts. Users must also understand the strengths and limitations of each database in meeting research needs.

- **Begin system design with the end in mind**

The system design should be based on the specific types of queries that will be made of the data and the types of analyses that will be performed. The search capabilities will be built to accommodate these uses, and the system will function more efficiently because the demands of the system were anticipated.

- **Stay aligned to big picture objectives**

By keeping the big picture in mind, identifying all of the potential use cases and then prioritising those cases to obtain rapid insights with high potential impact will ensure that the return on investment in a platform is recognised quickly. Initially plan to start with a limited number of use cases in order to keep the project manageable from a technology, investment, and management standpoint.

- **Cater to the ultimate consumers of the information**

It is important from the outset to think through how the data will be formatted and presented to end users. What data visualisations will be required? Ideally, the system will incorporate pre-configured analytics so that analyses can be accelerated.

- **Ensure that system developers understand clinical development and commercialisation domains**

It is essential that those responsible for building and maintaining an RWE platform have a domain expertise in technology, clinical research, and commercialisation. The applications are so specialised that the development process must reflect the knowledge and input of epidemiologists, health economists, data modelers, outcomes researchers, clinical operations, and statistical programmers. Ventures that are driven by IT and rely on pure technology players for design and development are doomed to fail for lack of clinical development know-how.

- **Understand that there is more to it than a technology platform**

Overall, an effective RWE strategy requires that both technology and the expertise of RWD specialists are brought to bear in seeing that data assets are specifically tailored to meet study endpoints most efficiently. Data are only optimised through a fully integrated and holistic approach.

Conclusion

Technology-enabled applications for analysing RWD and generating RWE are driving greater efficiency across the clinical research and commercialisation continuum. Sponsors can benefit from an understanding of what RWD are available and how they can be standardised, aggregated, and analysed within a powerful, fit-for-purpose platform. Indeed, this has the potential to greatly enhance decision making across the enterprise.

For users to derive full benefit from their strategic investment in RWD and technology, they must have access to a secure and compliant cloud-based platform solution that supports rapid and efficient collection, analysis, and reporting on the data. Effectively building a robust platform requires a multidisciplinary approach, with expertise in RWE strategy, big data technology, feasibility, observational research, health economics, and epidemiology. With a sound design, such solutions:

- Are highly scalable
- Support many diverse RWD assets
- Allow data assets to be segregated or shared at the study level
- Will control access rights for applications, dashboards, and insights, promoting data sharing and re-use

As the intersection of clinical research and clinical practice continues to expand, it becomes essential for sponsors to drive this convergence by using technology-enabled research applications and a fit-for-purpose platform. Such a platform can support a comprehensive RWE-generation strategy to drive research efficiency, enhance a product's value story, and provide sound evidence for targeted stakeholder engagement.

Contributors



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Jim is responsible for leading ICON's Real World Evidence Centre of Excellence hub in developing real world data and technology based solutions that support biopharmaceutical companies who are seeking to expand labelling and market access, while staying ahead of the growing demand for evidentiary requirements. Under Jim's leadership, ICON helps customers to demonstrate, within a real world context, their products' unique efficacy and safety attributes.



Bill Row, MBA, MS
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Bill has over 18 years of experience in study design and execution. He is a recognised leader in the design, operational strategy, and commercial applications of RWE late phase studies for both pharma companies and CROs. He has held leadership roles in clinical operations, project management, and strategy/innovation.



Michael Cook, MSc, MSPH, PhD
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Michael has 15 years of pharmaceutical company experience holding positions of increasing responsibility at Merck, Pfizer and Shire. His area of methodological expertise is in the analysis of large health care databases to conduct real world evidence (RWE) studies.



Otis Johnson, PhD, MPA
Vice President, Feasibility & Clinical Informatics

Otis has over 17 years of experience in clinical research, clinical research operations and informatics. He specialises in combining data and analytics with clinical, commercial and operational expertise in assessing study feasibility and developing strategies to identify study enrolment challenges from multiple perspectives, and modelling mitigations to address barriers to successful study implementation.



Bruce Capobianco
Senior Director, RWE Technology Services, Commercialisation & Outcomes

Bruce has over 20 years of experience in business technology and digital transformations. He has a proven track record leveraging technology as a facilitator for new innovative business capabilities. He is a sought after leader in the design and implementation of SaaS based, "Big Data" platforms. He has held various leadership roles in development, infrastructure, architecture and innovation teams across several distinct verticals.

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