

Transformation potential for Medicaid policy using counterfactual properties.

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Health care transformation obliges stakeholders in the ecosystem to coordinate. Private and public health plans articulate policy, provider networks deliver care, and patient's experience care. The glue that holds these stakeholders together is reimbursement. Transformation however requires more than manipulating policies of transactions. This project offers a new way to look at the entire ecosystem using a small set of TennCare data that illustrates how counterfactual methods can serve to extend the scope of information available for transformation.

Very briefly counterfactuals are entities that are actual, possible, real but unknown that can be selected or discovered inductively, or by thought experiments generated by analogy from experience. These entities may exist in a potential form of information that transcends transactions. Once identified as possibilities this full scope of information communicated with interoperable properties serves to bind the diverse ecosystem together. Transformation then is a possibility.

First Look: The Health Care Ecosystem Deconstructed

The following graphic shows the full scope of the health care ecosystem: the center is the patient centered moment; the trajectories represent journeys framed as intervals containing clusters of providers, codes, and path to value; the circumference represents real and potential population level outcomes.

In this case the circumference represents a global cost metric factored by hip fracture, pre and post from the TennCare data. The circumference may represent global metrics of any kind that originate from a population and serve as descriptions of transactional measures such as costs or codes or HEDIS measures. However, the circumference has many possibilities drawn from the ecosystem that function as outcomes of care processes, or the circumference may serve as possible metrics that are counterfactuals. In other words, potential outcomes that serve as targets for the future. Many policy level value metrics are in fact counterfactuals. To name examples, coordination of care and provider collaboration, and comparative cost and quality for value based purchasing are examples. Society level metrics such as social determinants of health, psychosocial influence on health, provider integration's effects on pricing, integration of mental health programs, provider network adequacy, and more are examples as well.

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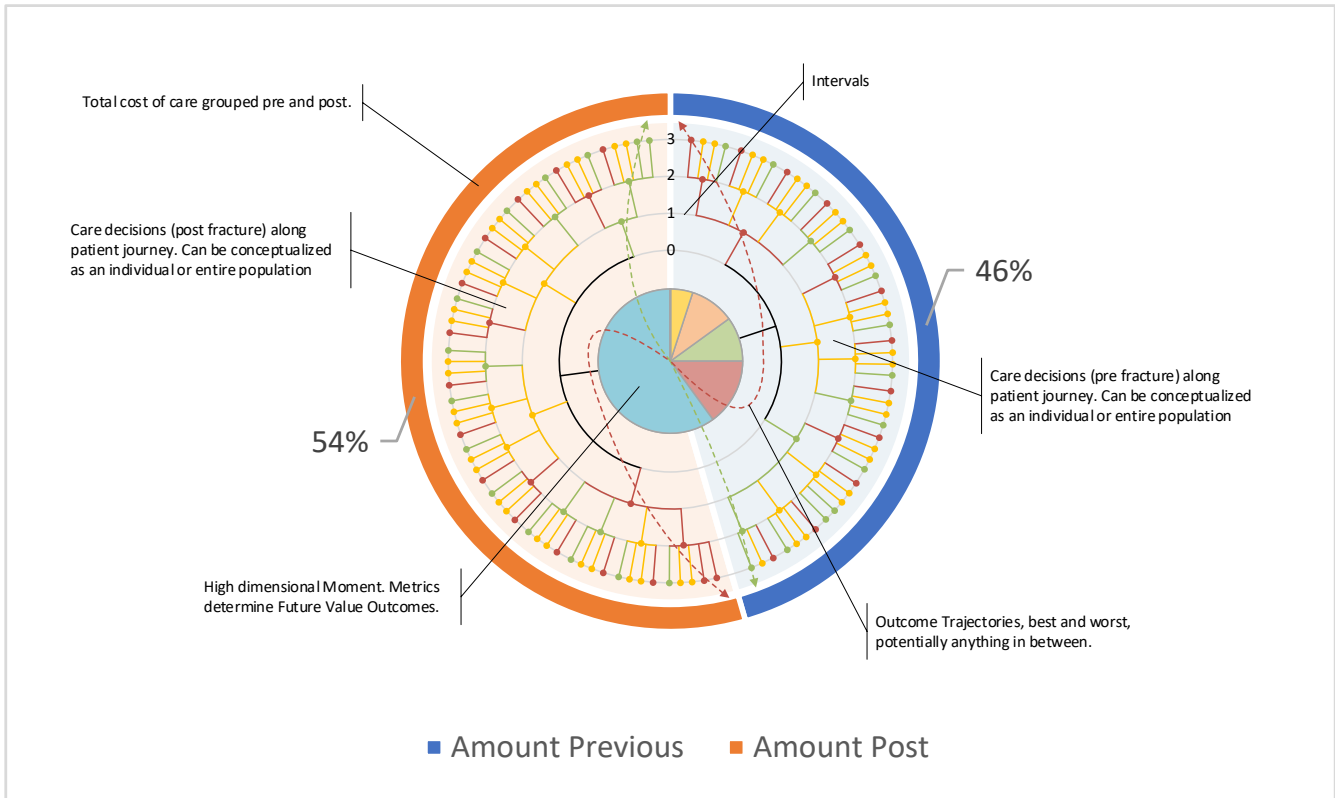
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Cost of care for the year before hip fracture diagnosis vs. cost of care after (outpatient services only).



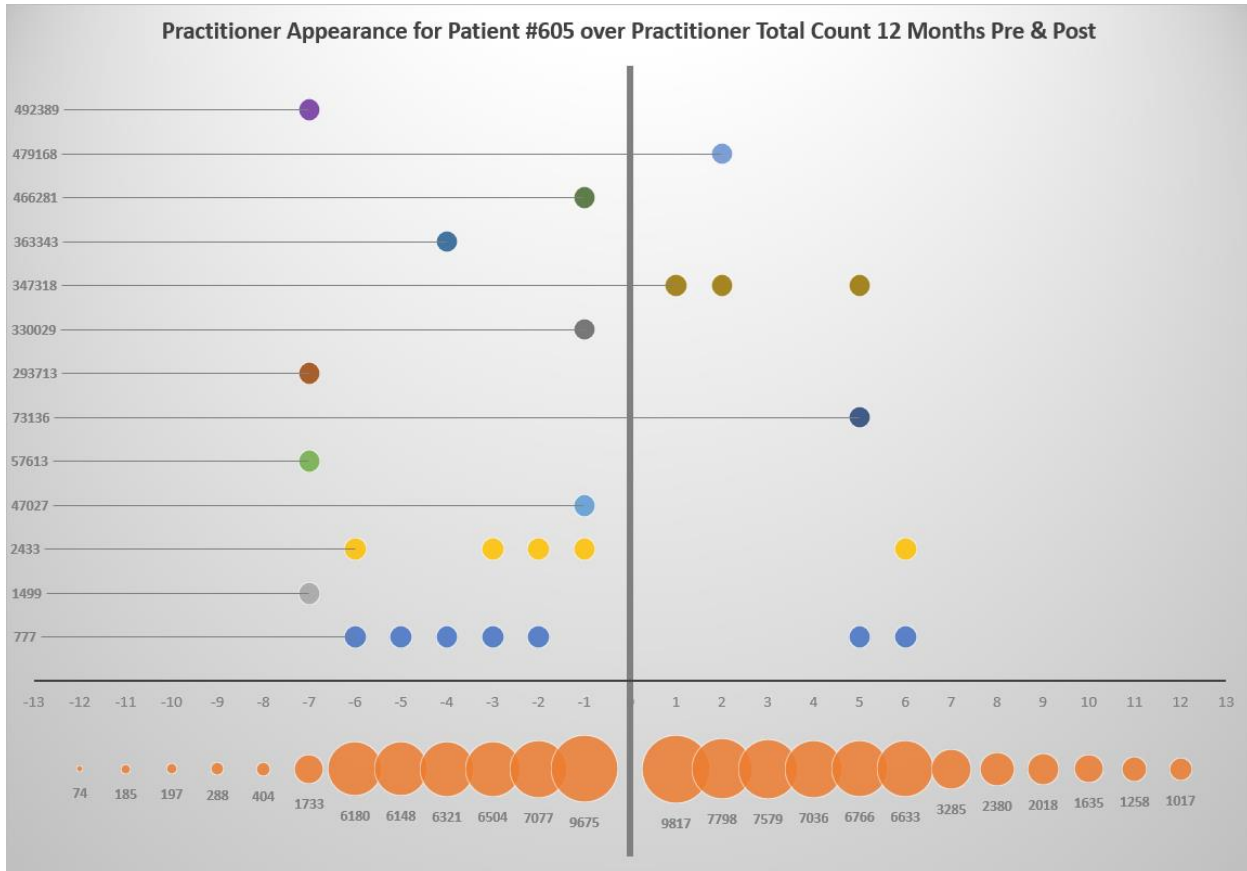
As transactional records, the claims data, in this case the hip fracture data for 1 year prior and 1 year post hip fracture, has patient and provider IDs, and locations of services. This data locates and describes as codes all services for 2 years. This graphic is an example of visually presenting claims data as a cost outcome of many journeys, each with an origin centered on the Moment of an episode or an event. Presenting this detail makes the cost outcome drawn from the ecosystem patient centered.

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The Network: Time Resolution of Journeys: Capturing the Relationships for Coordination and Collaboration



The above graphic shows at the patient level how many providers interact with the patient resolved in 1 month time intervals. The question is, as a counterfactual, how many providers interact with each on behalf of the patient. Fostering patient and provider coordination and collaboration in a journey through a provider network must account for the complexity of the ecosystem, in this graphic providers, and there are many more opportunities to find counterfactuals in aspects of the ecosystem that affect the patient. Focusing on the journey per patient and aggregated by population needs to have the focus narrowed. The hierarchical structure of the ecosystem as conceived in this TennCare project stratifies the patient, provider network, and population allowing an expectation that any entity exists with relationships to other entities. This hierarchical structure is graphed below under Provider Engagement. Focusing narrowly must not preclude understanding relationships. Any analysis as is done here will show the diversity of diagnoses and providers that change over time. Here a graphic shows the time resolution of journeys by 1 month intervals for the entire scope of time pre and post hip

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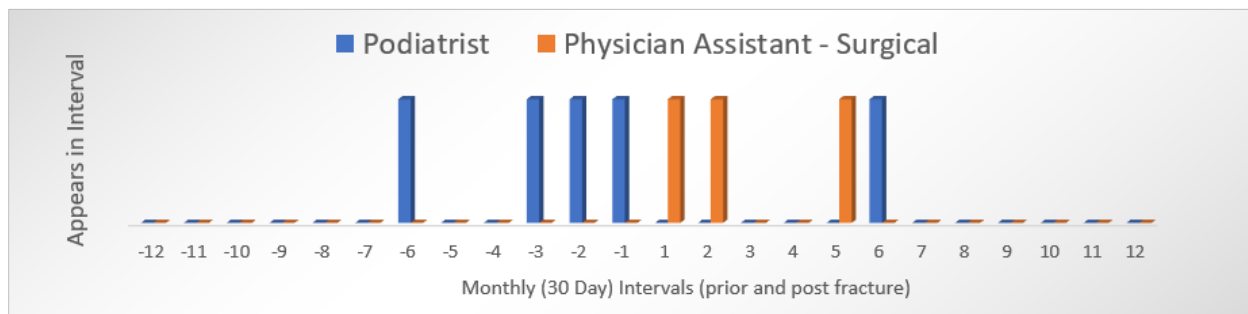
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fracture of 2 years. By focussing on a shorter time interval the concept of grouping by time comes into play. This will allow clusters of a variety of factors that proceed through a journey to be smaller than a larger group of the ecosystem, and will show the opportunity to define counterfactuals such as coordination of providers. Many other factors when so clustered can be assessed counterfactually, for example effects of social determinants of health on progress through journeys guided by provider networks that vary by input from a variety of support systems. Imagine long term services and supports existing in data at a level with imaging utilization, and complex medical procedures. Thus the network offers opportunities for narrowing the focus and highlights many counterfactual opportunities, which can be explored at the patient level moment.

This graphic below utilizes time resolution of journeys by showing, at the patient level, the presence of podiatrist encounters preceding hip fractures followed by surgical encounters. This may seem a trivial relationship, until understood as a counterfactual as a possibility of prevention.



Path to Value: Navigating Uncertainty through the Maze

Having the patient as the central focus is not only the best, but is the only way to navigate the maze of uncertainty as a patient centered entity, experienced by providers as well. The patient brings complexity to events, encounters, and acute and chronic care. This complexity exceeds what is captured by transactional data, as illustrated in the aforementioned radial graphic. To reiterate, the moment is in the center, and is the hub of journeys with trajectories, and results in outcomes of cost and quality seen as a perimeter of many journeys on the path to value.

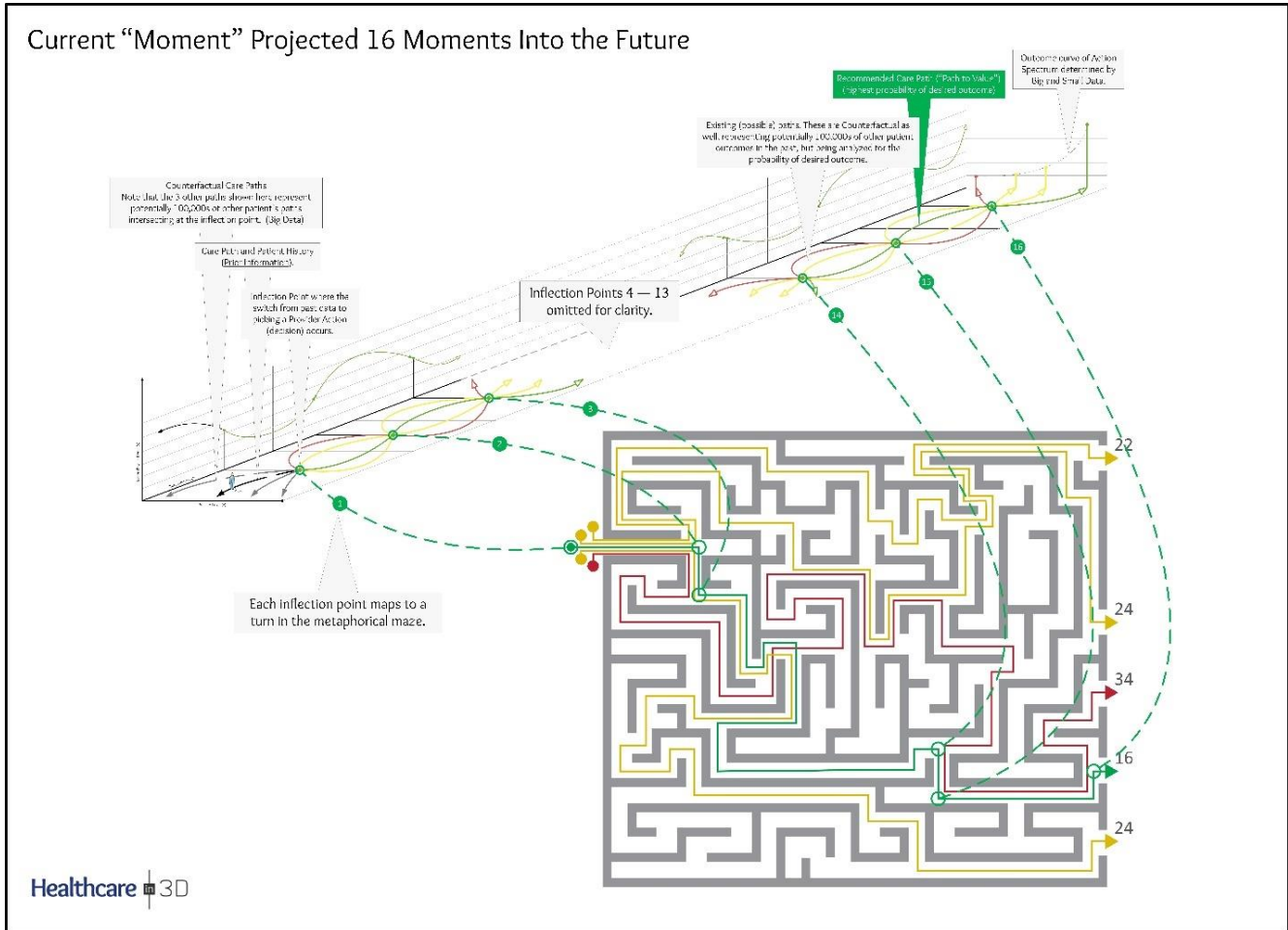
This illustration shows the complexity of moments in a journey a sequence of periods and intervals in that journey. The sequence replicates a moment and when resolved by time intervals, the moment changes by past history and potential actions and outcomes potentially in the future. The counterfactuals aspect of the changing moment is that potential counterfactuals change as well, some are realized and become facts, and some are discarded, and some remain possibilities. This process can be illustrated in detail with an analysis of journeys at

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the patient level, with an even greater complexity at the population level. In generalizing to the population the ability of counterfactual properties to simplify and reduce data will make the maze amenable to simplification. An illustrative project can compare patient centered journeys with and without use of counterfactual properties.



This path to Value from the patient through the maze directed to optimum outcomes has many possibilities. As mentioned above, counterfactual properties are simply repeatable possibilities known as transactions from the past or possible non-actualized occurrences in the future. Going from the past to the future requires interoperability, not in the technical sense but in the sense of information that not only exists as data, but is possible and able to become information and is effectively communicated. For example, cost analysis based on post hip fracture may include the information where podiatrists commonly see patient that end up with hip fractures. The counterfactual property illustrated is a possibility of other outcomes following podiatry visits other than hip fracture raising the counterfactual possibility of prevention. This time resolution into intervals



over time offers the counterfactual property of identifying clusters of providers that differ from others by a variety of metrics where fraud detection will be enhanced or cost efficiency of provider groups virtual or formal can be compared. The counterfactual property applied to complex, high dimensional composite moments on the path to value will show the infinite number of possibilities for all the factors existing at each moment. Here the counterfactual property comes from interoperability in the moment where the uncertainty from so many possibilities is reduced with care coordination and collaboration. Another counterfactual property is a distance measure between encounters, where this distance raises the possibility of enhanced access for some providers. There are many counterfactual properties associated with enhanced access.

The potentially most effective use of counterfactual properties is with the TennCare plan itself. The large scale of the plan offers insight not available in the moment, or even with large integrated provider networks. The plan transactions have the possibility of showing patient and provider level behaviors, use of imaging and procedures with variations linked to individual providers or clusters. The administrative burdens imposed on providers and the plan itself can be treated as a counterfactual property where the possibility of no burden can be realized with identification of excessive utilization. The most important counterfactual property for the plan is interoperability. Where information for all these issues is considered a possibility as care coordination and collaboration among providers is inserted into patient journeys. This will involve providers as willing partners with TennCare.

Question: We will look at how an observation of a distance measure can show how a patient centered metric compares to a population. The distributions are similar, and though not linked to clinical insight, this may have importance on social determinants of health where access for an individual is similar for a population. An induced counterfactual property from the TennCare record, Provider Distance, allows the question does the distance the recipient (patient) has to travel impact value via access to care. This motivates the counterfactual analysis which will specifically include surrogates of access such as specialists, levels of care, and coordination of rural and urban care to name a few surrogates.

Answer: The distance between the recipient's zip code and the providers service address, affords an opportunity, when presented in the interval format, to cluster any or all surrogates of distance. It's Not surprising the sum of the Distance Between Patient and Provider increases around the Hip Fracture across the entire domain. What is interesting is that for recipient #605, there is a secondary increase at 5 to 6 months post. It is notable that the time resolved clusters of encounters for a single patient resembles clustering of the population as a whole. The benefit of using counterfactual properties allows what is true and real for a single patient to be applied to the population as a whole. An example property is provider skill at the moment to include social determinants of health and psychosocial factors where the presence of this skill set shows how influence with knowledge at the patient level is repeatable within the population. This comparison of the patient to the population offers counterfactual possibilities that include awareness of personal and social factors not available directly from population generated transactional data.

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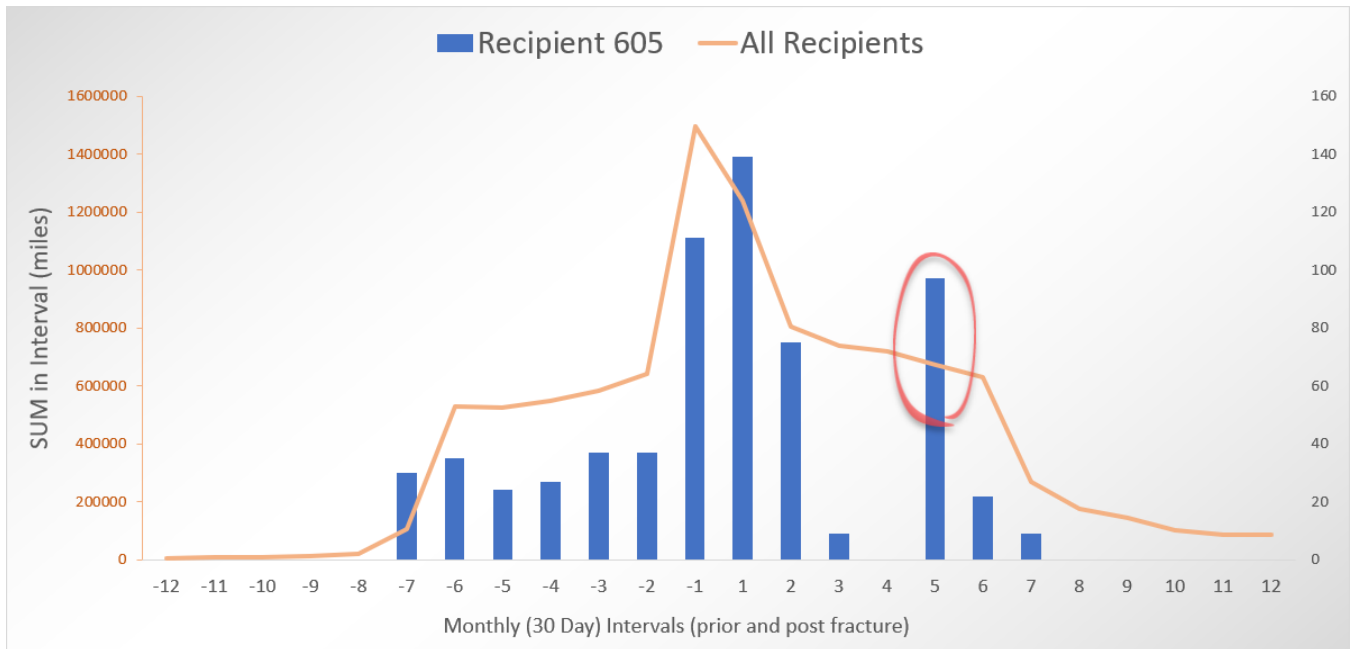
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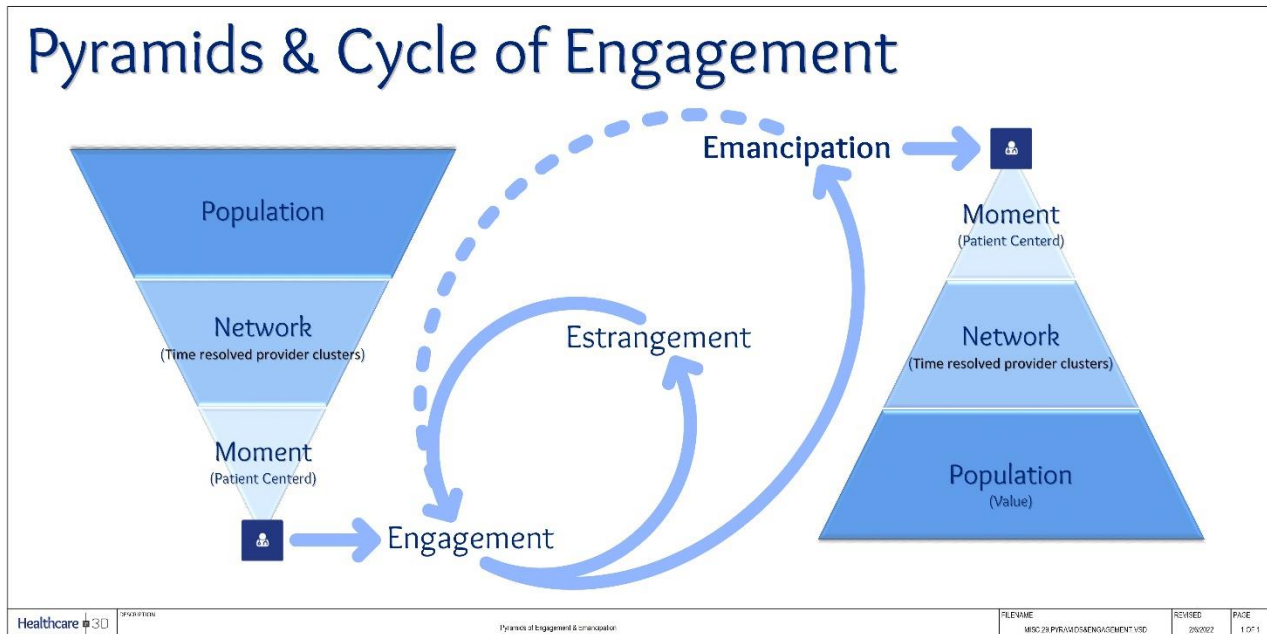
Note: Transactions on the first day of diagnosis are included in the previous interval.

Physician Engagement: Counterfactual Possibilities are the Key

Engagement effects, from value based purchasing policy, can be complemented by extending into the realm of physician facility and interest to support and manage the full gamut of patient level complexity. Of all TennCare and Medicaid policies in general there is nothing more powerful than engaging providers. This graphic shows the hierarchical structure of the ecosystem and where patient centering will give a novel approach to the value of information for the provider. The inverted pyramid with the patient centered on top signifies counterfactual possibilities as known to the patient and providers, compared to transactional information in the other pyramid as the basis of value based purchasing. The belief is that capturing what physicians do and how they perform off



the grid, if you will, will capture and engage physicians. This will result when physicians discover counterfactual possibilities in their realm.



Physician engagement is the lodestone of health care transformation. Of all the spaces of the health care ecosystem, the moment centered on the patient is the essential time and place of transformative efforts.

The following graphic is an illustration from the TennCare data showing the dynamics of medical codes over time demonstrates in a limited way how complex the patient is in the moment

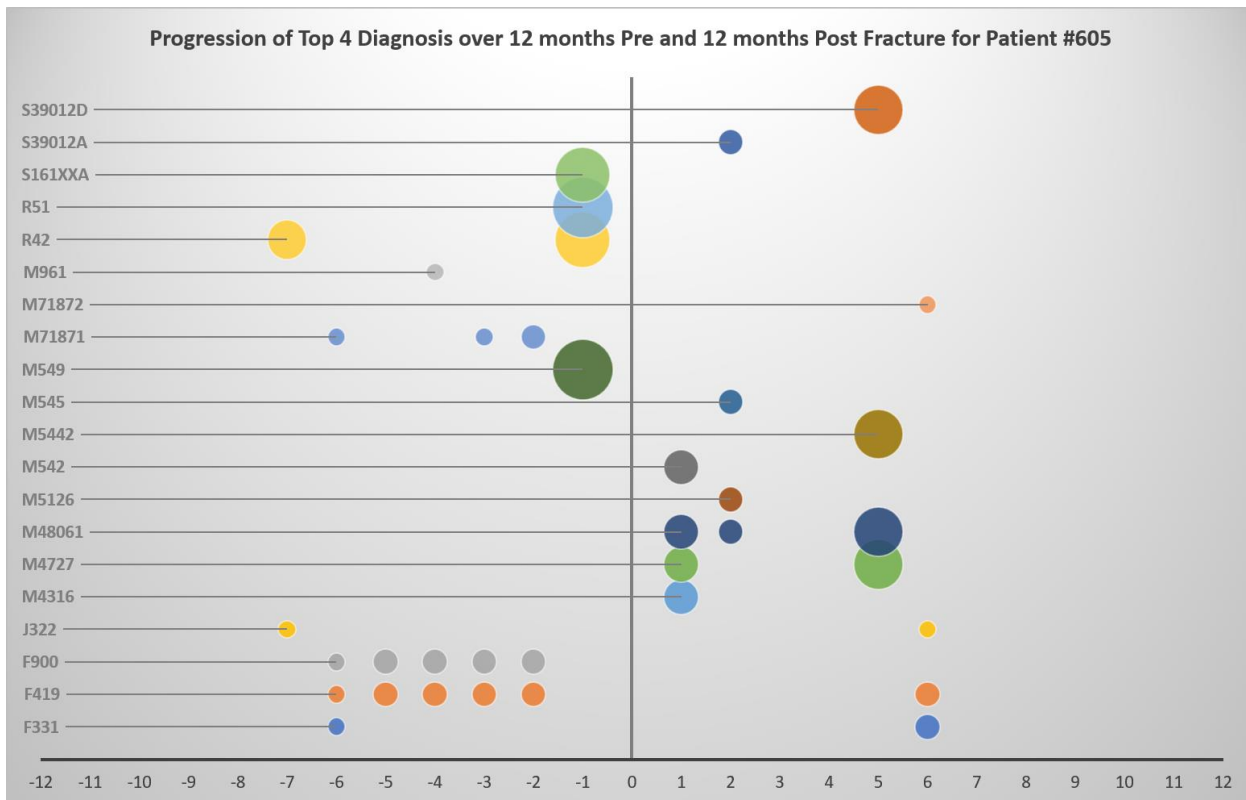
Question: Building yet again on our previous examples we will look at the progression of diagnostic codes across intervals pre and post fracture. Is there a pattern of diagnoses that suggest counterfactuals?

Answer: Yes, An obvious pattern of F900, F419 (psychological) and then just before the fracture, multiple diagnosis of M549, M71871, R42, (foot, back, dizziness, headache, neck). Could there be causal relationship between the psychological and the physical condition of patient #605 that contributed to the hip fracture?

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This graphic is a vivid example of the complexity and diversity of provider input into the patient’s journey. One sees, if one wades through the details, that for the 2 year series of time resolved intervals, there are 21 different top 4 diagnostic codes for a single patient. How would counterfactual properties help? First, is there interoperability among the providers? What is the potential for a quarterback to direct care? Can unnecessary care be located in this sequence? Is there a difference in global 2 year costs based on characteristics of providers, disease states, patient care seeking behavior? The counterfactual possibilities are infinite, and this approach is a reasonable way to initiate conversations.

Summary:

Health care transformation need not be as overwhelming and seemingly impossible as it is made out to be. Not shying away from the sheer scale, complexity, diversity, social, medical and financial footprint more must be done than to expect results by relying on transactional information alone. This project offers an expanded view using counterfactual possibilities into a complementary world of information that is potential, future oriented, and ideally suited for implementing multiple plan-based value opportunities.

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Next steps:

How to do the “Quantum Leap” into coordination of TennCare plan components

Question and answer period to allay the strangeness of using counterfactual possibilities in the real world

Analysis of Episodes of Care interoperability opportunities

Translation of TennCare cost reduction policy to provider groups with counterfactual possibilities

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