

RACGWVI: Presentation

Constructing a Clinical Gulf War Illness (GWI) Case Definition Using Natural Language Processing and Advanced Machine Learning Algorithms



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Constructing a Clinical Gulf War Illness (GWI) Case Definition Using Natural Language Processing and Advanced Machine Learning Algorithms

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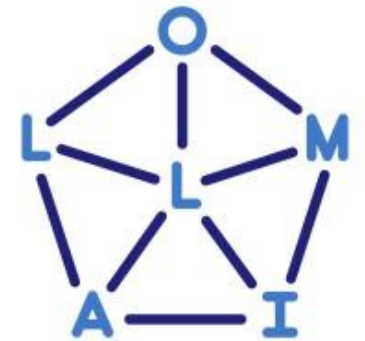


U.S. Department
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Overarching Goal

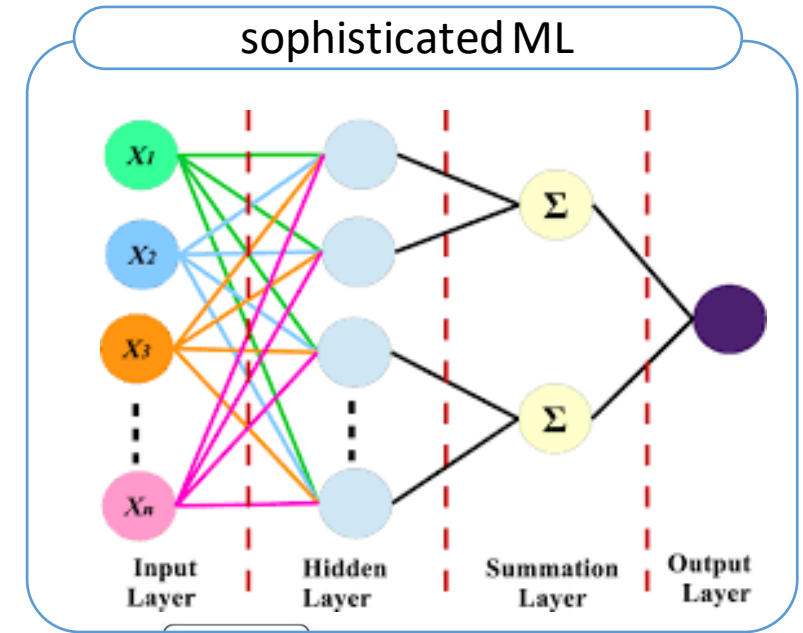
- The **overarching goal** of this application is to **develop a case definition** of **Gulf War Illness (GWI)** for application in the Veterans Health Administration (**VA**) electronic medical record (**EMR**) using Artificial Intelligence (**AI**) such as advanced machine learning, Natural Language Processing algorithms (**NLP**) based on Large Language Models (**LLMs**).



What Is the Product?

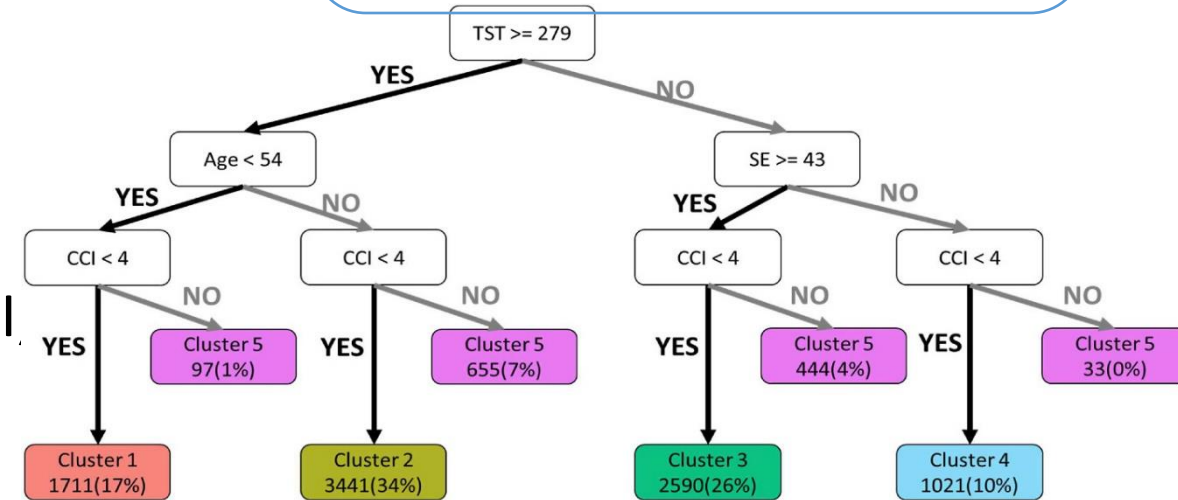
1. GWI index or score.

- It is a continuous score produced by **sophisticated ML** algorithms that ranges from **zero** to **1**. The higher score represents the highest probability of GWI.



2. Highly interpretable

- ML algorithms that can be used in conjunction with clinical evaluation and existing symptom-based criteria for GWI, such as Kansas and CDC.

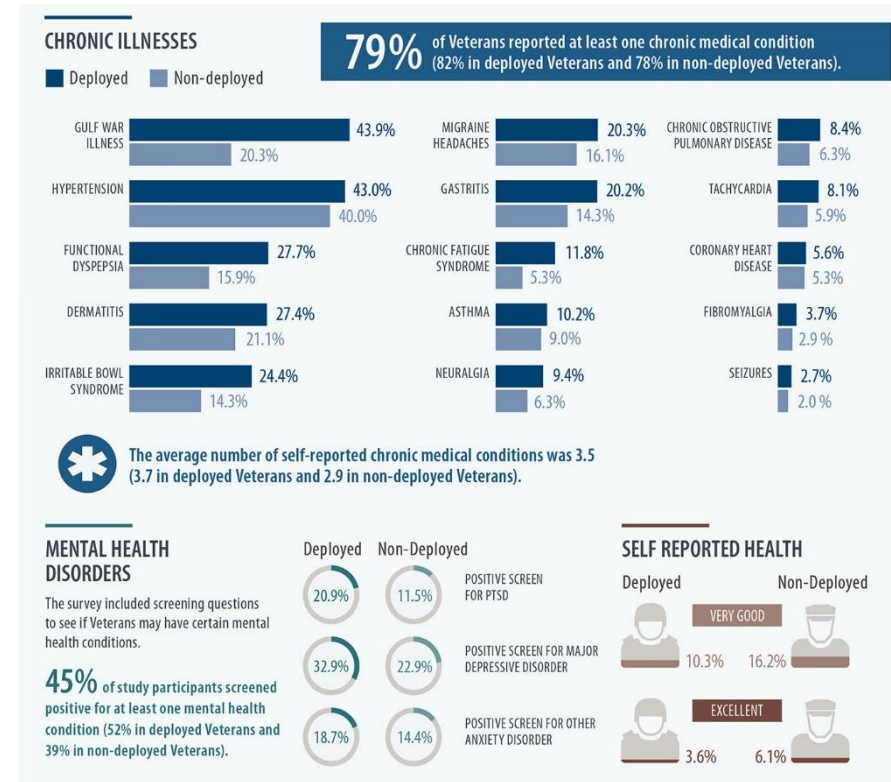


TST = Total Sleep Time, CCI = Charlson Comorbidity Index, SE = Sleep Efficiency

Razjouyan, J., Hanania, N. A., Nowakowski, S., Agrawal, R., & Sharafkhaneh, A. (2024). Identification of sleep phenotypes in COPD using machine learning-based cluster analysis. *Respiratory Medicine*, 227, 107641.

What We Know

- Deployment ¹⁻⁴:
 - Veterans from the Persian Gulf War (GW, 1990–1991) continue to experience medical issues, notably Gulf War illness (GWI).
- Numbers ¹⁻⁴ :
 - This ailment affects 15 to 45% of the 693,826 deployed Americans and is attributed to toxic exposures encountered during the war.
- Common symptoms of GWI ¹⁻⁴
 - chronic fatigue, pain, respiratory issues, gastrointestinal problems, skin conditions, and neurological disturbances.
- Two definitions for research ^{5,6} :
 - 1) Kansas Definition (GW, 1,548 and non-GW, 482)
 - 2) Centers for Disease Control and Prevention (CDC) Chronic Multi-symptom Illness (CMI) Definition (n= 3723)

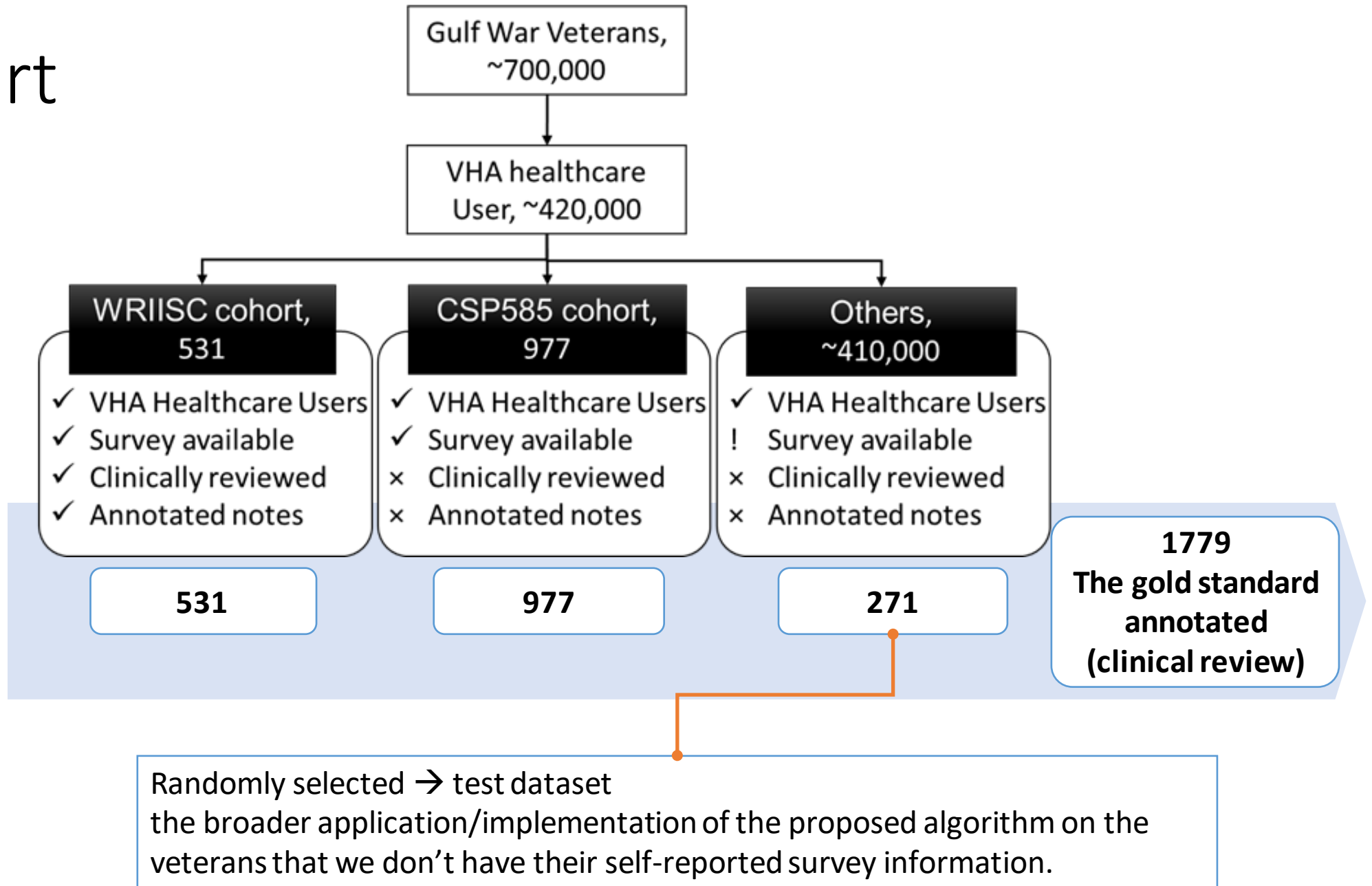


1. Fappiano CM, Baraniuk JN. Gulf war illness symptom severity and onset: a cross-sectional survey. *Military medicine*. 2020;185(7-8):e1120-e1127.
 2. Nettlemann M. Gulf war illness: challenges persist. *Transactions of the American Clinical and Climatological Association*. 2015;126:237.
 3. Duong LM, Nono Djotsa AB, Vahey J, et al. Association of Gulf War Illness with Characteristics in Deployed vs. Non-Deployed Gulf War Era Veterans in the Cooperative Studies Program 2006/Million Veteran Program 029 Cohort: A Cross-Sectional Analysis. *International Journal of Environmental Research and Public Health*. 2022;20(1):258.
 4. Gifford EJ, Vahey J, Hauser ER, et al. Gulf war illness in the Gulf war era cohort and biorepository: the Kansas and centers for disease control definitions. *Life sciences*. 2021;278:119454.
 5. Steele L. Prevalence and patterns of Gulf War illness in Kansas veterans: association of symptoms with characteristics of person, place, and time of military service. *American journal of epidemiology*. 2000;152(10):992-1002.
 6. Fukuda K, Nisenbaum R, Stewart G, et al. Chronic multisymptom illness affecting Air Force veterans of the Gulf War. *Jama*. 1998;280(11):981-988.
 7. Shine K, Bloom F, Cook K, Cory-Slechta D, Friedberg F, Grossblatt N. Chronic multisymptom illness in Gulf War Veterans: case definitions reexamined. 2014;

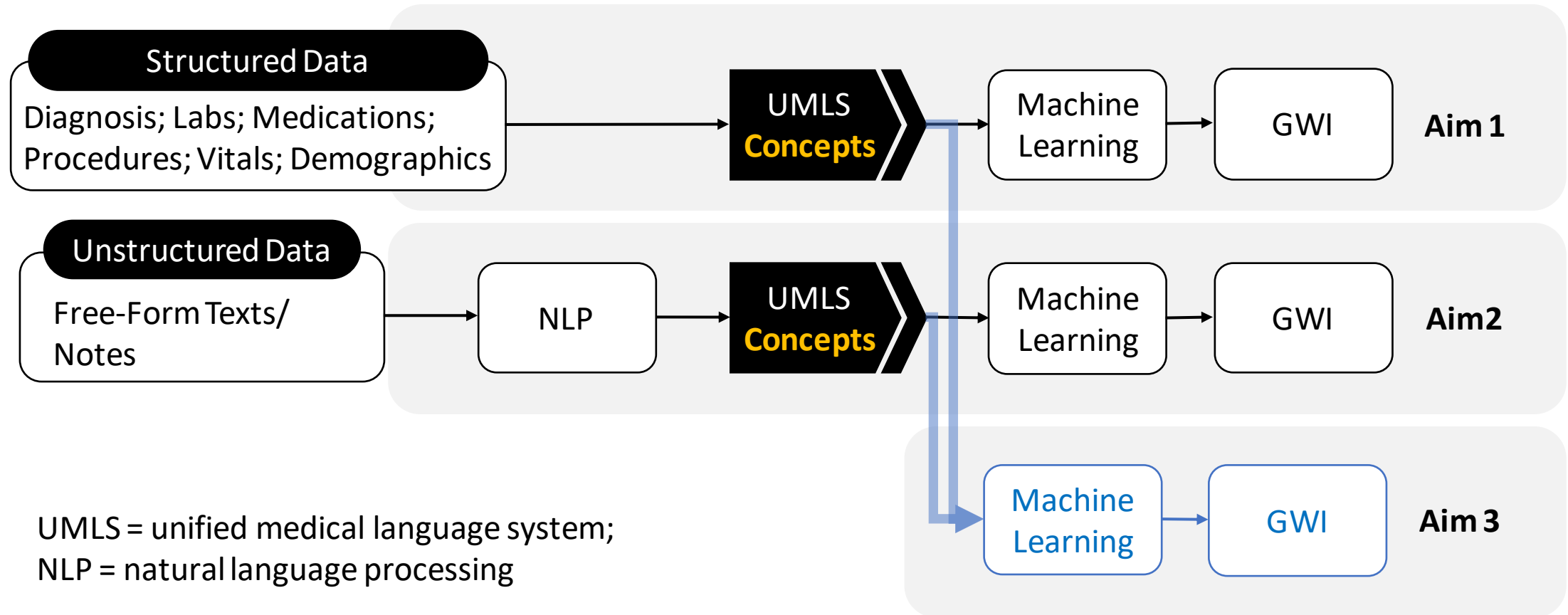
Innovation

- **Real World Data → Real-World Evidence**
 - We will utilize the full breadth of **EMR** (e.g., diagnosis and procedure codes, lab results, medications, healthcare utilization, and free text from clinician notes).
- **Advanced Analytics**
 - The proposed transformer-based algorithm (Large Language Model [**LLM**]) has the potential to robustly extract signs and symptoms from VHA and non-VHA sources.

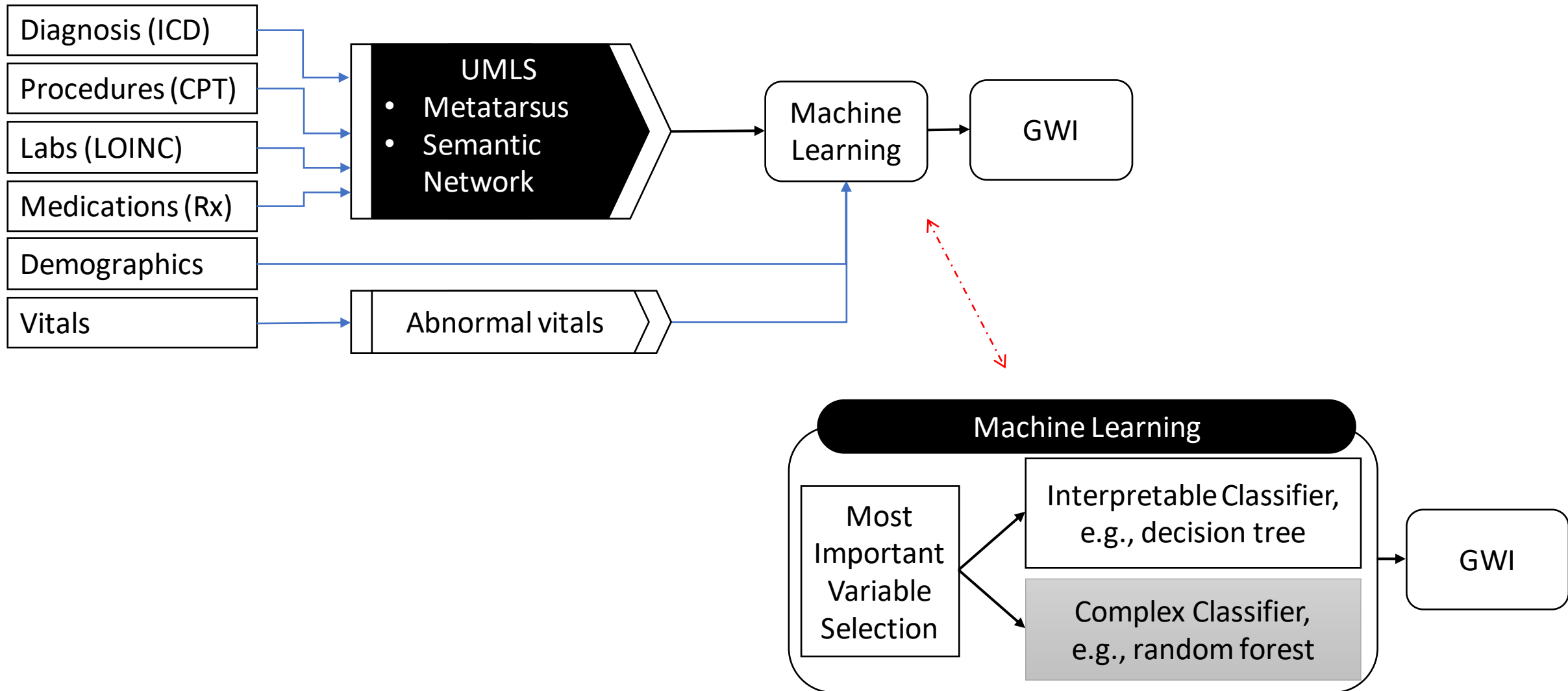
Cohort



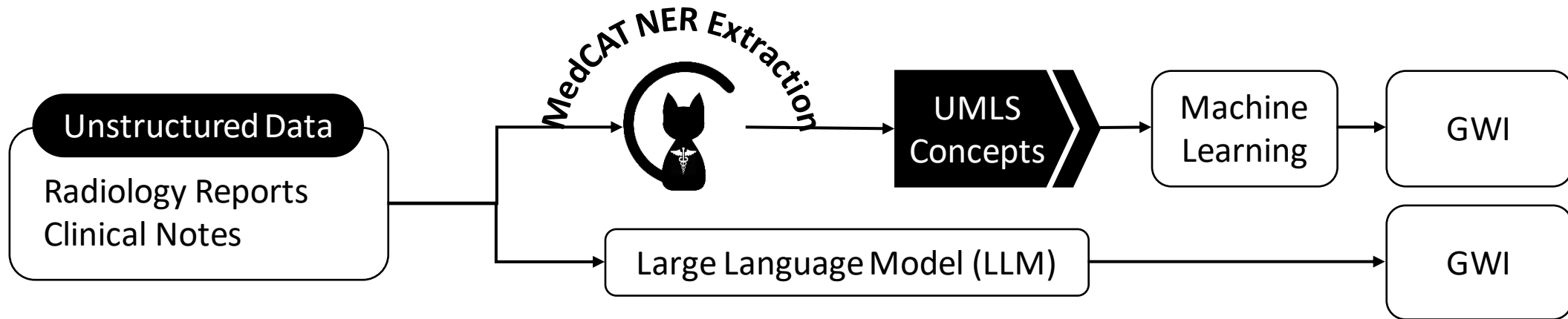
Gulf War Illness (GWI) – Aims Briefly



Aim 1:

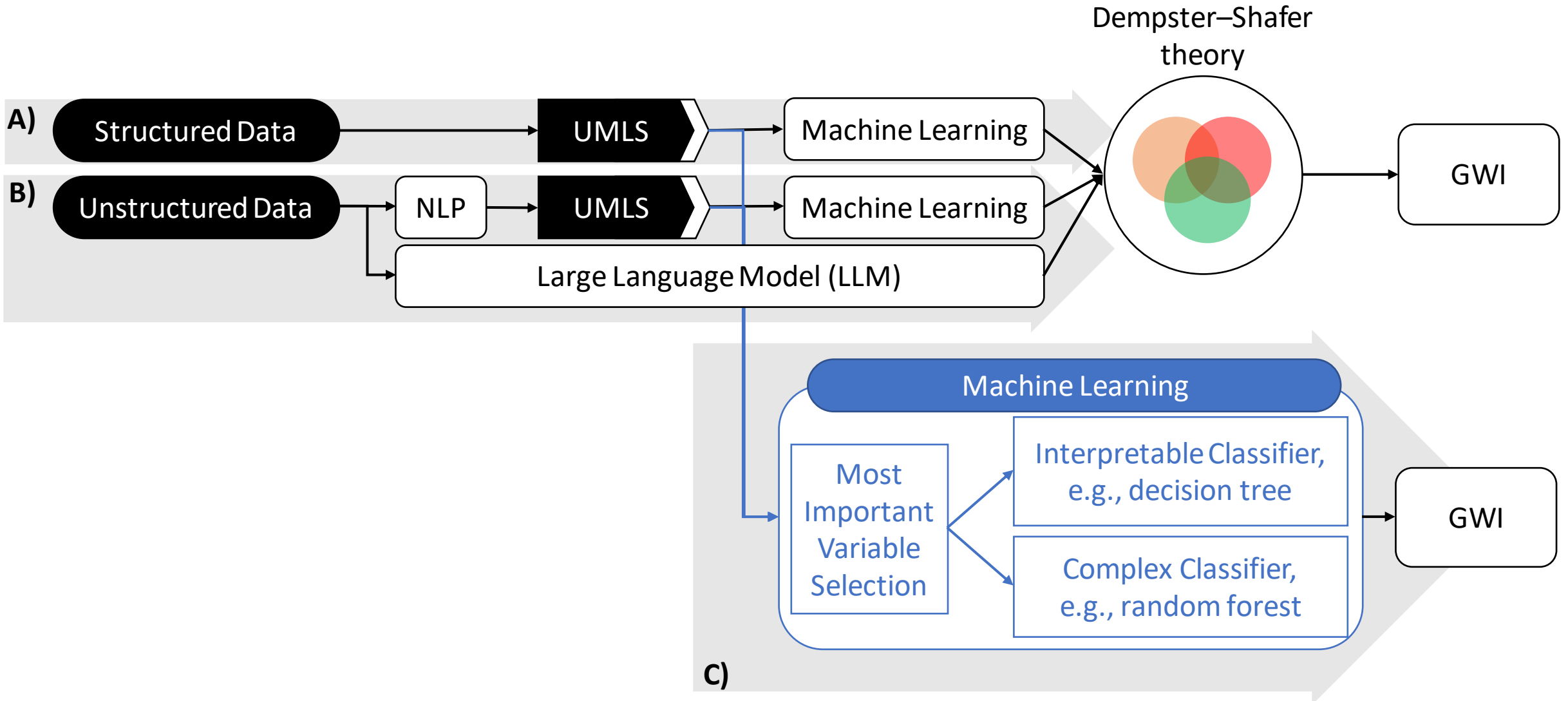


Aim 2



NLP = natural language processing; NER = named entity recognition; UMLS = unified medical language system; Medical Concept Annotation Toolkit (MedCAT)

Aim 3



Implication

- Inform a clinical decision support to improve clinical evaluation
- Identify potential research participants
- Identify “hot spots” - facilities with high numbers of Veterans with GWI to match resources to needs