

Luoluo Liu¹, Swearingen Dennis², Eran Simhon¹,
Kulkarni Chaitanya¹, David Noren¹, Ronny Mans¹

¹ Philips Research, ² Banner health

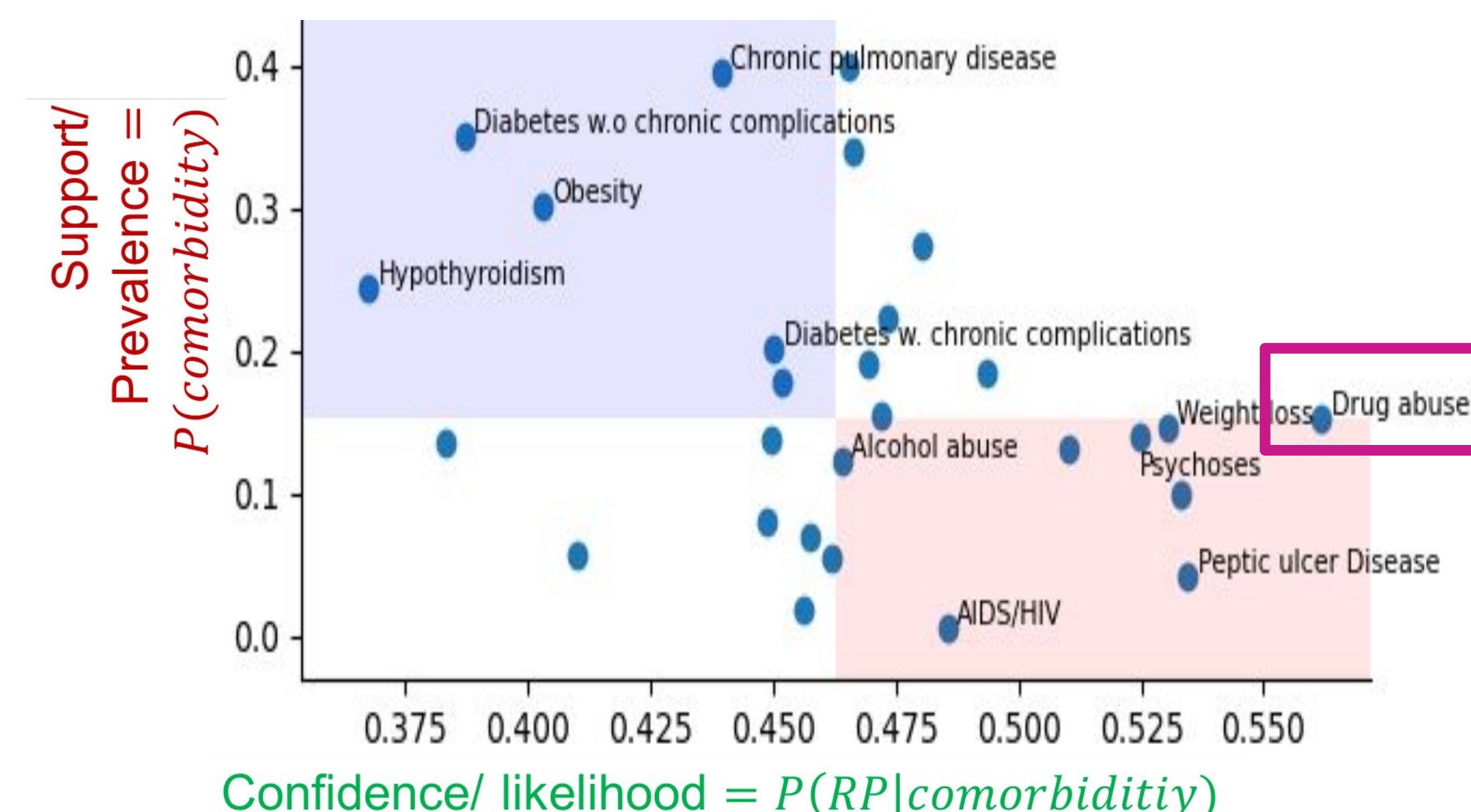
Introduction

1. Recurrent patients (RP) are a **small** group; however, they impose a disproportionately **high utilization** of hospital resources.
2. Two major types of reasons reported from literature: 1. **mental health or substance (drug and/or alcohol) abuse** 2. **some chronic diseases** such as AIDS
3. Social-behavioral interventions and outpatient care could be introduced to reduce future recurrent visits.

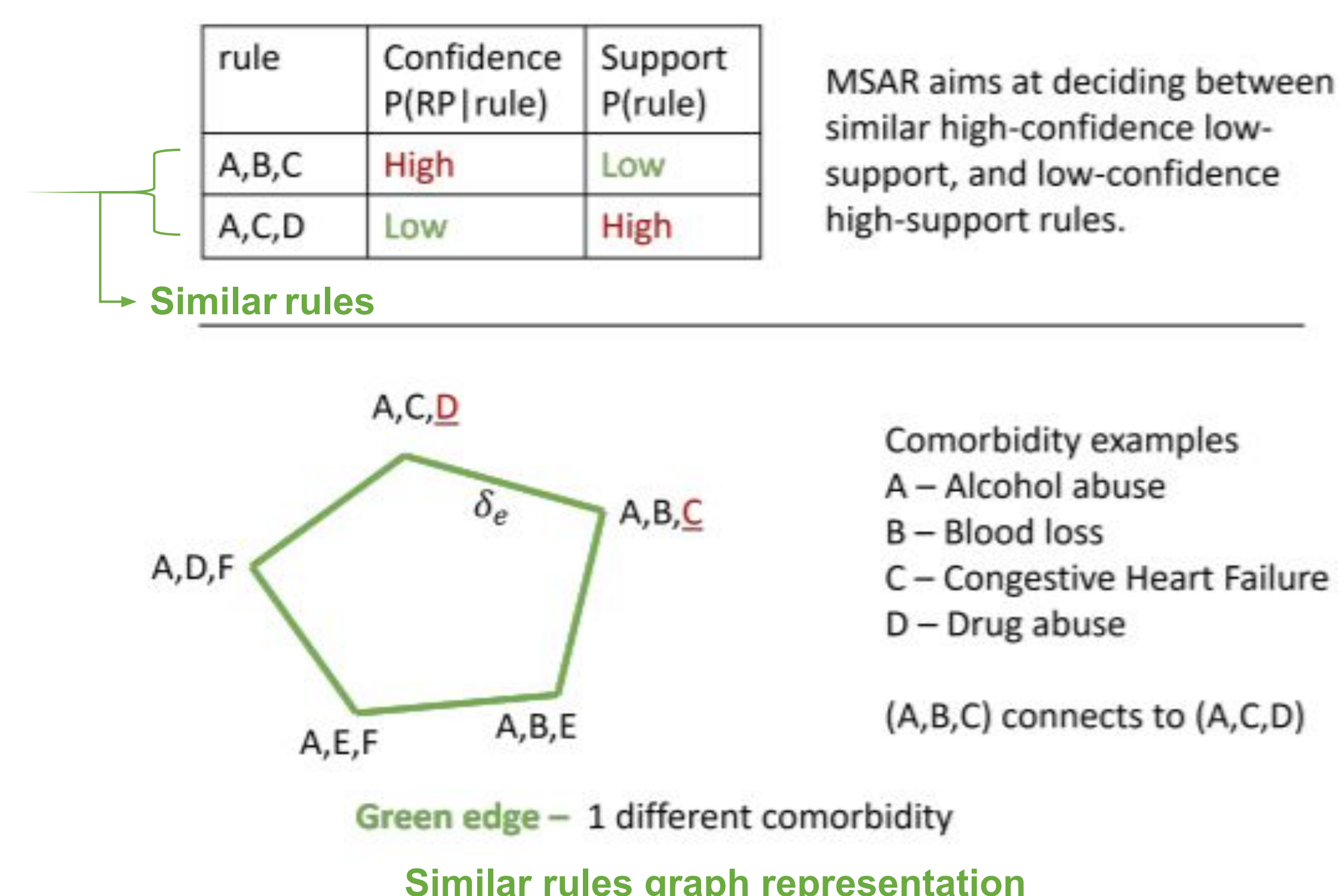
Challenges:

1. No standardized criteria to identify RP
2. The lack of **interpretable** tools for selecting top reasons associated with recurrent visits
3. No ground truth labels for top factors.

Challenge: some comorbidities associated with recurrent visits (**high confidence**) are of **low prevalence/support**



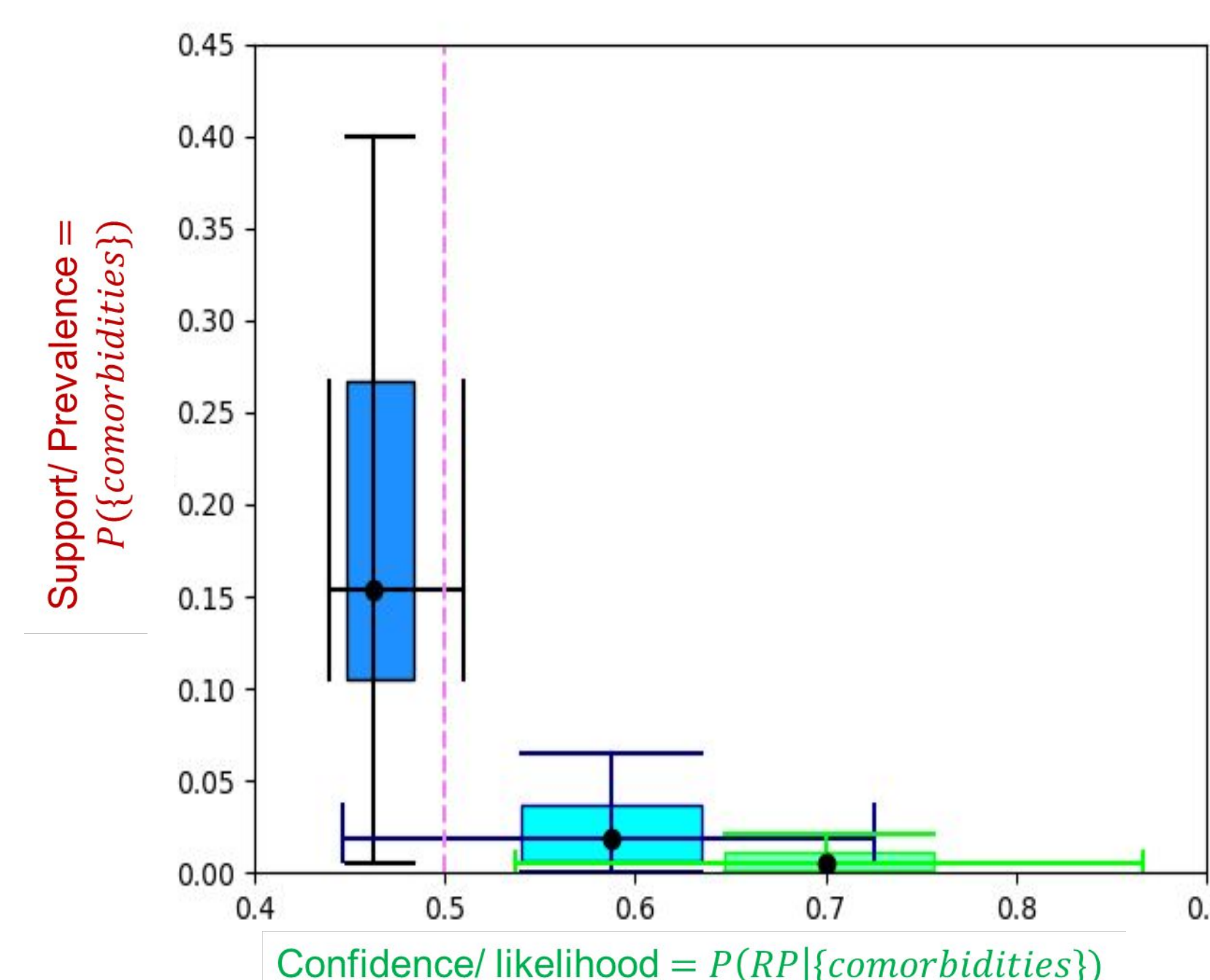
Proposal: Min.-Similarity Association Rules (MSAR)



Algorithm innovations in MSAR

1. To balance conf-supp trade-off, we use a weighted average of confidence and support
2. Weights of confidence and support are learned from retrospective data by minimizing MSAR rule scores on pairs of similar rules on the similarity graph G

Challenge: increasing the number of comorbidities **increases** the **likelihood/confidence** of identifying PR, however **decreasing** the **prevalence/support**.



Conclusions

Algorithms	AR ^[1] (Association rules)	XGBoost ^[2] + Shap values ^[3]	MSAR (Ours)
Interpretability	Yes	Medium	Yes
Balance conf-supp trade-off	No	No	Yes
Ability to select high-conf, low-supp comorbidities	Limited	Limited	Yes
Consistency	High	medium	High
Ability to distinguish across comorbidities	Limited	Limited	Yes

[1]. Agrawal R., Imieliński T., and Swami, A., 1993, "Mining association rules between sets of items in large databases," in *Proceedings of ACM SIGMOD international conference on Management of data*.
[2]. Chen, T. and Guestrin, C., 2016, "XGBoost: A Scalable Tree Boosting System," in *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*.
[3]. Lundberg, S. M and Lee, S.-I., 2017, "A Unified Approach to Interpreting Model Predictions", in *Advances in Neural Information Processing Systems*.

Main achievements of MSAR algorithm innovation:

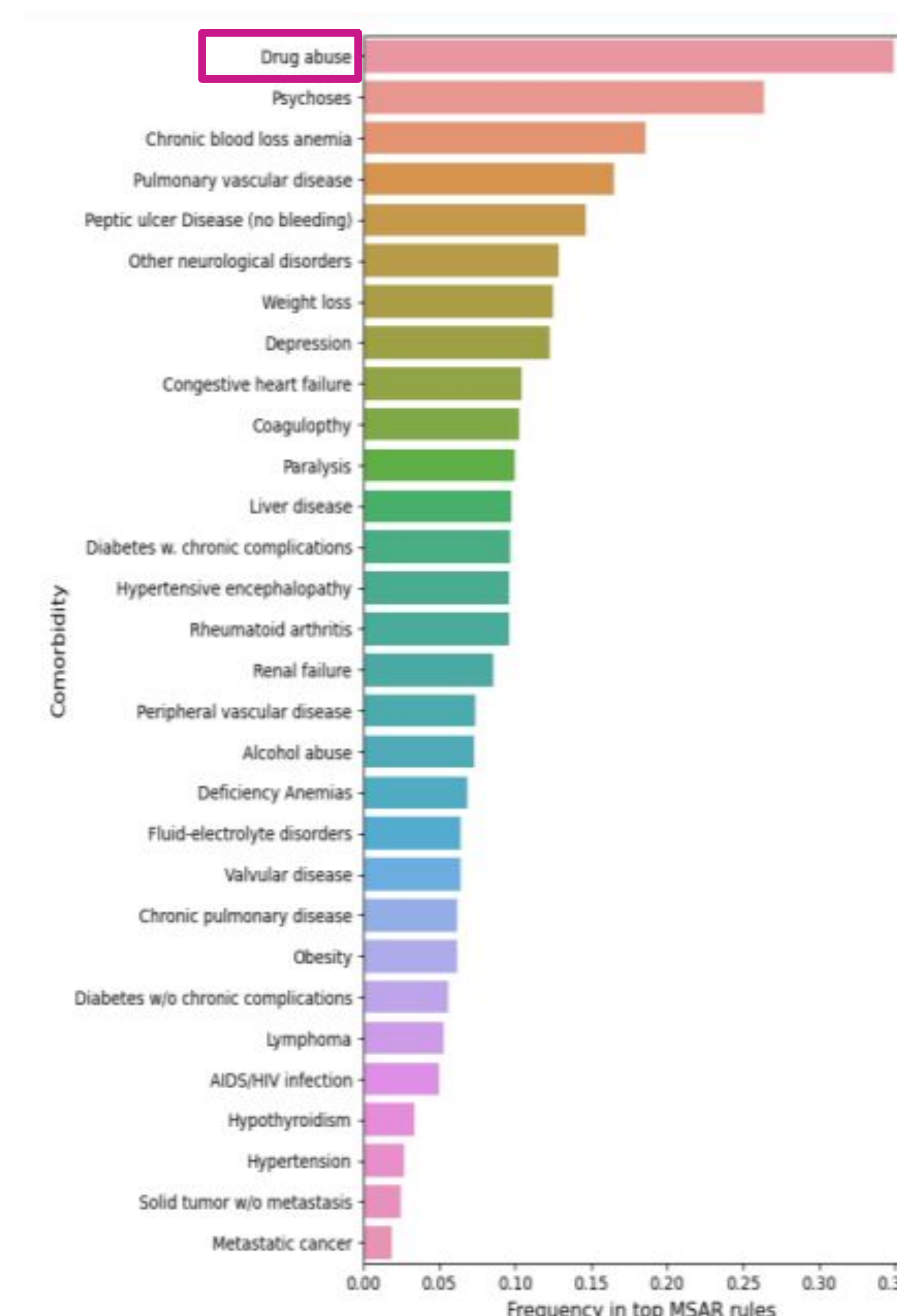
1. **balances confidence support trade-off**, weights learned from data
2. consistently identifies **high confidence** comorbidities associated with recurrent visits but **low support**
3. has a **general usage** in selecting a combination of significant (Top-X) factors

Acknowledgement & Contact

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Contact author: Luoluo Liu (luoluo.liu@philips.com)

Results



The figure shows the frequency of comorbidities from the top 25% of learned MSAR rules. Drug abuse, even with low prevalence compared to other comorbidities, has been successfully identified as being in 35% of those top rules for recurrent visits. **MSAR successfully selects challenging high-confidence, low-support comorbidities relate to recurrent visits**