



# Development of an online database of published usable mapping algorithms used to estimate EQ-5D utilities.

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## INTRODUCTION

A systematic literature review (SLR) was conducted of published mapping algorithms across multiple disease areas used to predict EQ-5D (5L or 3L) utilities. A classification system was created that categorized the performance of mapping algorithms as either 'Poor', 'Useful' or 'Ready to Use' based on standard measures of performance. A database of the classification (freely available) is available at [www.r-s-s.com](http://www.r-s-s.com).

## OBJECTIVES

- To identify all published mapping algorithms.
- To classify the usefulness of mapping algorithms.
- To provide a freely available database of the classification system.

## METHODS

We searched the available databases (including PubMed, Cochrane). We identified common performance metrics of mapping algorithms (e.g.,  $R^2$  and Root Mean Squared Error (RMSE)). We classify these using monte-carlo simulation methods and advocate a new classification system using the population distribution of the performance metrics of the form:

$$\Pr[(\Omega_j \geq 0) | \Lambda, A_i] \geq \Delta, \text{ for } \Lambda \in \{\text{measures such as } R^2\}$$

$$\Pr[(\Omega_j < 0) | \Lambda, A_i] \geq \Delta, \text{ for } \Lambda \in \{\text{measures such as RMSE, MAE}\}$$

Where,  $\Omega_j = (\theta_j^* - \hat{\mu})$ ,  $\theta_j^*$  is an overall average performance metric and  $\hat{\mu}$  is an overall performance measure across algorithms and  $A_i$  is each algorithm. Based on this, algorithms are classified as 'Poor', 'Useful/Use with Caution' or 'Ready to Use'.

## RESULTS

**Table 1: Identified Mapping Algorithms & Performance Metrics**

Disease Area	Identified Algorithms N = 186	Mean $R^2$ Value (SD)	Mean RMSE Value (SD)
Oncology	41 (22.04%)	0.645 (0.127)	0.108 (0.050)
Mixed Disease Types <sup>a</sup>	32 (17.20%)	0.739 (0.255)	0.032 (0.059)
Musculoskeletal	23 (12.37%)	0.537 (0.212)	0.116 (0.118)
Mental Health	21 (11.29%)	0.351 (0.136)	0.123 (0.061)
Neurology	17 (9.14%)	0.473 (0.183)	0.145 (0.088)
Chronic Disease	10 (5.38%)	0.518 (0.111)	0.112 (0.061)
Central Nervous System	8 (4.30%)	0.468 (0.091)	0.137 (0.046)
Rheumatology	8 (4.30%)	0.571 (0.089)	0.152 (0.044)
Cardiovascular	6 (3.23%)	0.519 (0.124)	0.123 (0.069)
Stomach & Bowel	4 (2.15%)	0.289 (0.165)	0.160 (0.122)
Endocrine Disorder	4 (2.15%)	0.440 (0.156)	0.169 (0.050)
Respiratory	3 (1.61%)	0.395 (0.069)	0.188 (0.037)
Urogenital	3 (1.61%)	0.483 (0.361)	0.143 (0.052)
Dermatology	2 (1.08%)	0.275 (0.063)	0.166 (0.046)
Other <sup>b</sup>	4 (2.15%)	0.425 (0.114)	0.083 (0.097)

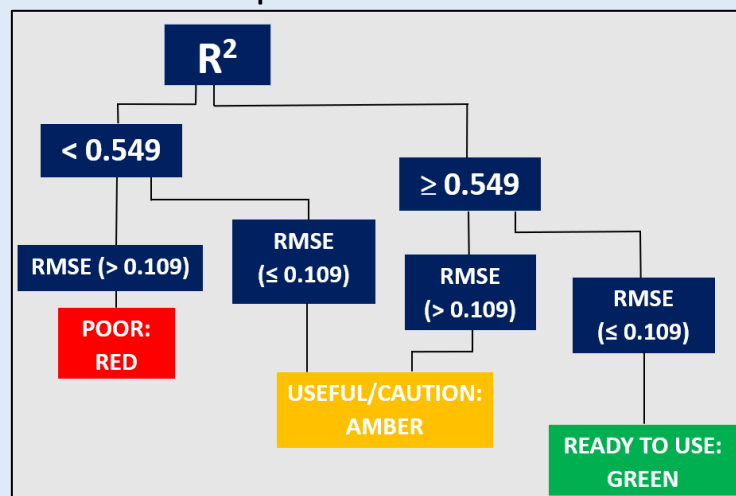
RMSE: Root Mean Square Error; SD: Standard Deviation; <sup>a</sup>Mixed Disease Types include different populations with diseases such as chronic pain, injuries, cancer, or no disease; <sup>b</sup>including Hematology, Autoimmune, Sleep Disorder, Ophthalmology.

## REFERENCES

Dakin H, Abel L, Burns R, Yang Y. Review and critical appraisal of studies mapping from quality of life or clinical measures to EQ-5D: an online database and application of the MAPS statement. *Health Qual Life Outcomes*. 2018 Feb 12;16(1):31. doi: 10.1186/s12955-018-0857-3. PMID: 29433510; PMCID: PMC5810002. Walloo A., Hernandez Alava, M., Pudney, S. NICE DSU Technical Support Document 22 Mapping to estimate health state utilities. 2023 [Available from <http://www.nicedsu.org.uk>]. Algorithm I: Kay, S., Tolley, K., Colayco, D., Khalaf, K., Anderson, P., & Globe, D. (2013). Mapping EQ-5D utility scores from the Incontinence Quality of Life Questionnaire among patients with neurogenic and idiopathic overactive bladder. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research*, 16(2), 394-402. <https://doi.org/10.1016/j.jval.2012.12.005>. Algorithm II: Ruiz, M. A., Gutiérrez, L. L., Monroy, M., & Rejas, J. (2016). Mapping of the OAB-SF Questionnaire onto EQ-5D in Spanish Patients with Overactive Bladder. *Clinical drug investigation*, 36(4), 267-279. <https://doi.org/10.1007/s40261-016-0377-z>. Algorithm III: C. Coon, A. Bushmakina, S. Tatlock, N. Williamson, M. Moffatt, R. Arbutuckle & L. Abraham (2018) Evaluation of a crosswalk between the European Quality of Life Five Dimension Five Level and the Menopause-Specific Quality of Life questionnaire, *Climacteric*, 21:6, 566-573, DOI: 10.1080/13697137.2018.1481381

From a total of 556 identified published mapping algorithms, 186 publications reported both  $R^2$  and RMSE values. The most common disease area was Oncology (22.04%) and Musculoskeletal (12.37%). 35% of identified algorithms were classified as red ('Poor'), 38% were classified as amber ('Use with Caution') and 27% were classified as green ('Ready to Use'). The 'usable' algorithms were considered as performing at either above or below average (the expected mean estimate of the metric of interest).

**Figure 1: Classification tree for mapping algorithms identified from 186 publications.**



**Table 2: Example of Urogenital Mapping Algorithm Classification (using 3 algorithms)**

Algorithms (Disease Area: Urogenital)	Simulated $R^2$ Value (Mean)	Simulated RMSE Value (Mean)	% of times simulated $R^2$ > mean estimate	% of times simulated RMSE <= mean estimate	Classification
Algorithm I	0.271	0.148	7%	32%	Poor
Algorithm II	0.784	0.199	92%	13%	Useful/Caution
Algorithm III	0.371	0.111	18%	53%	Poor

Publication details for Algorithms I, II, III reported in References.

Following the classification tree (Figure 1) and Table 2, 2 out of 3 mapping algorithms identified in the Urogenital disease area were classified as 'Poor' and 1 out of 3 algorithms which reported both  $R^2$  and RMSE values was classified as 'Useful/Caution'.  $R^2$  and RMSE values were simulated at least 5000 times for each algorithm reported in Table 2.

## CONCLUSIONS

Classification of mapping algorithms is feasible. A database of the classification is provided at [www.r-s-s.com](http://www.r-s-s.com) which offers a rich source of structured information on the use of mapping algorithms consistent with the guidance provided in NICE DSU TSD 22 (June 2023). This will be a valuable resource updated regularly and freely available to academics and pharmaceutical companies for economic evaluation.