COMP0190 Project Preparation T2 Module

MSc Artificial Intelligence for Sustainable Development (AI4SD)
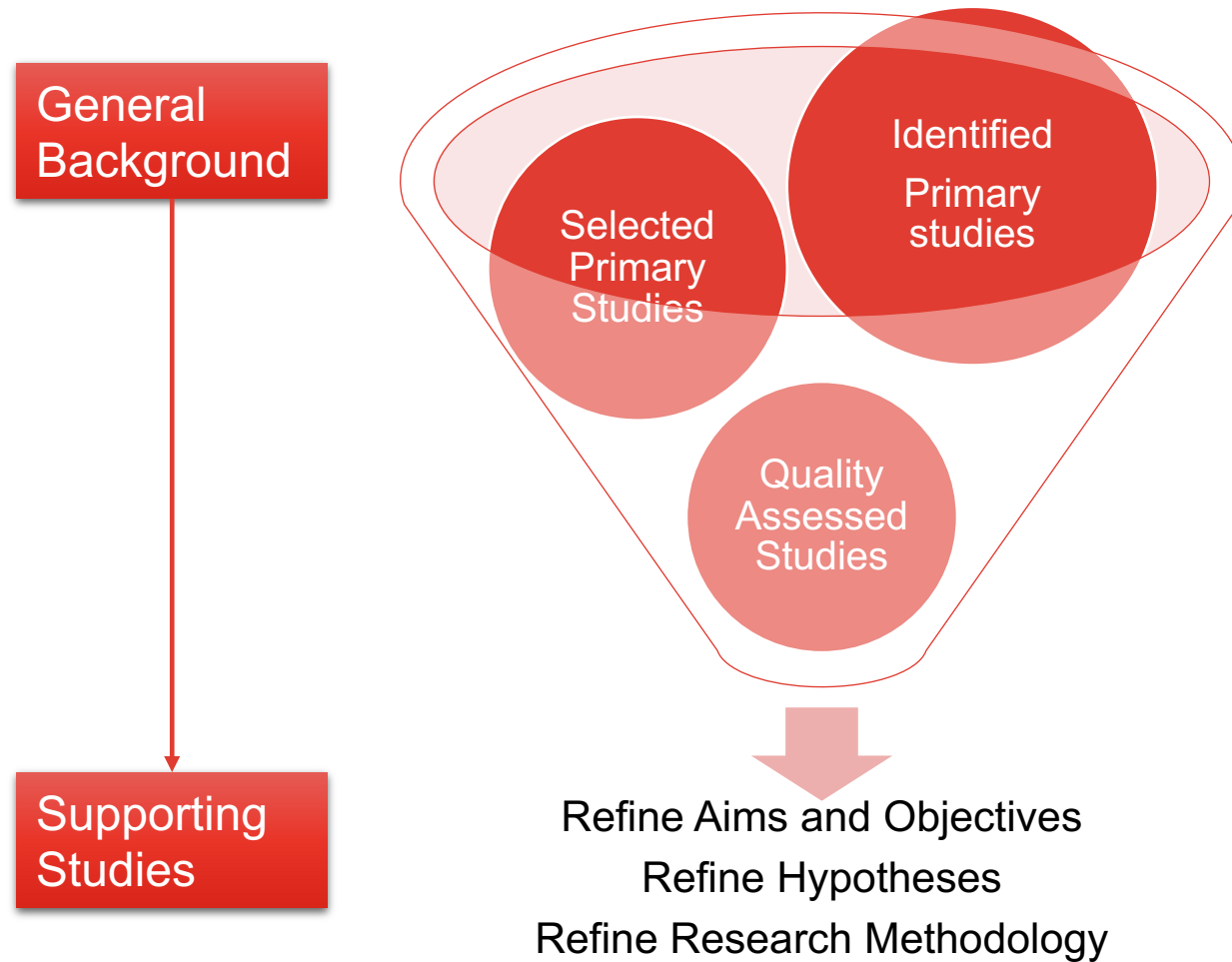
MSc Artificial Intelligence for Biomedicine and Healthcare (AI4BH)

Prof. Delmiro Fernandez-Reyes
Monday 6th February 2023

The Literature Review
Part 02

Prof. Delmiro Fernandez-Reyes

Monday 3rd February 2023

General
Background

Supporting
Studies

Selected
Primary
Studies

Identified
Primary
studies

Quality
Assessed
Studies

Refine Aims and Objectives
Refine Hypotheses
Refine Research Methodology

Literature Review Process – Phases / Steps

1. Formulate a clear research question

2. Define inclusion and exclusion criteria

3. Develop and evaluate the review protocol

planning

4. Conduct a comprehensive and systematic search for relevant studies

5. Screen the titles and abstracts to determine eligibility for inclusion in the review

6. Assess the full text of eligible studies for quality and relevance

7. Extract relevant data from eligible studies

8. Synthesize the data extracted from eligible studies

    a. Narrative synthesis, meta-analysis, or qualitative synthesis

    b. Synthesis of findings from multiple studies

9. Evaluate the quality of the evidence and the risk of bias

10. Draw critical conclusions and refine research hypotheses

conducting

11. Make recommendations based on the evidence synthesized in the review

12. Disseminate the findings of the review

reporting

- Drive the entire systematic / integrative / structured review methodology.

- Cover the subject area or problem within the scope of the project

- Closely linked to a project aims, objectives and hypotheses

  - A specific problem (P) is tackled

  - using some specific constraints, methods and/or approaches (C)

  - to develop a solution, system, application or algorithm (S)

- Identify what existing solutions are available and how they compare

- What is the strength of the evidence is and what implications these solutions have

- **RQ1** What are the existing solutions to P?

- **RQ2** How does different solutions addressing RQ1 compare to each other with respect to C?

- **RQ3** What is the strength of the evidence in support of the different solutions?

- **RQ4** What implications will these findings have when creating S?

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- Defines how each step is to be carried out to support reproducibility.

- A pre-defined protocol is necessary to reduce researcher bias.

- **Includes:**

  - The Research Question: rationale and research questions the drives the review.

  - Sources and Search Strategy: data sources and search strategy

  - Selection Criteria: determine which studies are included or excluded

  - Selection Procedures: how the selection criteria will be applied.

  - Quality Assessment: checklists and procedures.

  - Data Extraction Strategy: how information required will be obtained.

  - Synthesis of Extracted Data: synthesis strategy it should clarify what type of review

  - Dissemination strategy and project timetable

CW1

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- Document an Justify sources to be used

- Define the search strategy by

  - Creating groups of words to be used by

  - applying OR operator within the groups and AND operator between the groups

Data Source	Documentation
Digital Library	Name Search strategy for the database Date of search Years covered by search
Other sources	Date Searched/Contacted URL Any specific conditions

	Group 1	Group 2	Group 3
Term 1	*Synonym 1*	*Synonym 2*	*Synonym 3*
Term 2	*Synonym 1*	*Synonym 2*	*Synonym 3*
Term 3		*Synonym 2*	

CW1

planning

Simple Example: Study comparing AI methodologies in the biomedical and healthcare domain

	Criteria	Justification
Inclusion	• Studies comparing AI methodologies used in the application domain. • Studies reporting performance of accuracy, precision, recall, or other relevant metrics. • Studies that use real-world data sets or relevant simulated data sets. • Studies published in peer-reviewed journals between the years 2015-2022.	
Exclusion	• Studies that do not report quantitative results on the performance of AI methodologies. • Studies that use small or limited data sets. • Studies that have not been peer-reviewed or published in scientific journals.	

- A more detailed inclusion/exclusion criteria to add rigour

- Provides What is the <u>strength of the evidence</u> in support of the different solutions?

- To assess whether quality differences provide an explanation for differences in study results

- As a means of weighting the importance of individual studies when synthesising results

- To guide the interpretation of findings and determine the strength of inferences

- **Bias** and **validity** problems can occur at different stages [design-conduct-analysis-conclusions]

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Bias *Systematic Error* Results depart systematically from the 'true' results	Selection or *Allocation Bias:* Systematic Error in the assignment of subjects or treatments in a study or experiment.
	Performance Bias Systematic differences in the care provided to subjects in different treatment groups.
	Measurement or *Detection Bias* Systematic differences in the way outcomes are detected between treatment groups.
	Attrition or *Exclusion Bias* Systematic error in the selection of subjects or data for inclusion in a study or experiment.
Internal Validity	*Validity* Extent to which the design and conduct of the study prevent systematic error.
External Validity	*Generalizability or Applicability* Extent to which the effects observed are generalizable and applicable outside of the study.

- The impact of bias on the study results can lead to false conclusions undermining the validity.

- To reduce by implementing blinding procedures and clear inclusion/exclusion criteria.

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Quality Criteria	Evaluation Questions
Study Design	• Is the study design appropriate for the research question? • Is the study design appropriately described and justified? • Is the study design free from potential biases?
Sample Selection	• Is the sample selection process described and justified? • Is the sample size appropriate and justified? • Is the sample representative of the target population?
Data Collection	• Is the data collection process described and justified? • Are the measurement instruments validated and reliable? • Are the data collected in a standardized manner?
Data Analysis	• Is the data analysis plan described and justified? • Are the statistical methods appropriate for the data and research question? • Are the results presented clearly and accurately?
Ethics	• Are the ethical considerations of the study adequately addressed? • Has informed consent been obtained from participants? • Is confidentiality and privacy of participants protected?
Generalizability	• Is the study generalizable to the target population? • Are the results of the study applicable to the intended audience?

- Is there is a clear statement of the aim of the research?

- Is the study is put into context of other studies and research?

- Are system or algorithmic design decisions justified?

- Is the test data set open and reproducible?

- Is the study algorithm reproducible?

- Is the experimental procedure thoroughly explained and reproducible?

- Which other algorithms the study's algorithm(s) have been compared with?

- Are the performance metrics used in the study explained and justified?

- Are the test results thoroughly analysed?

- Does the test evidence support the findings presented?

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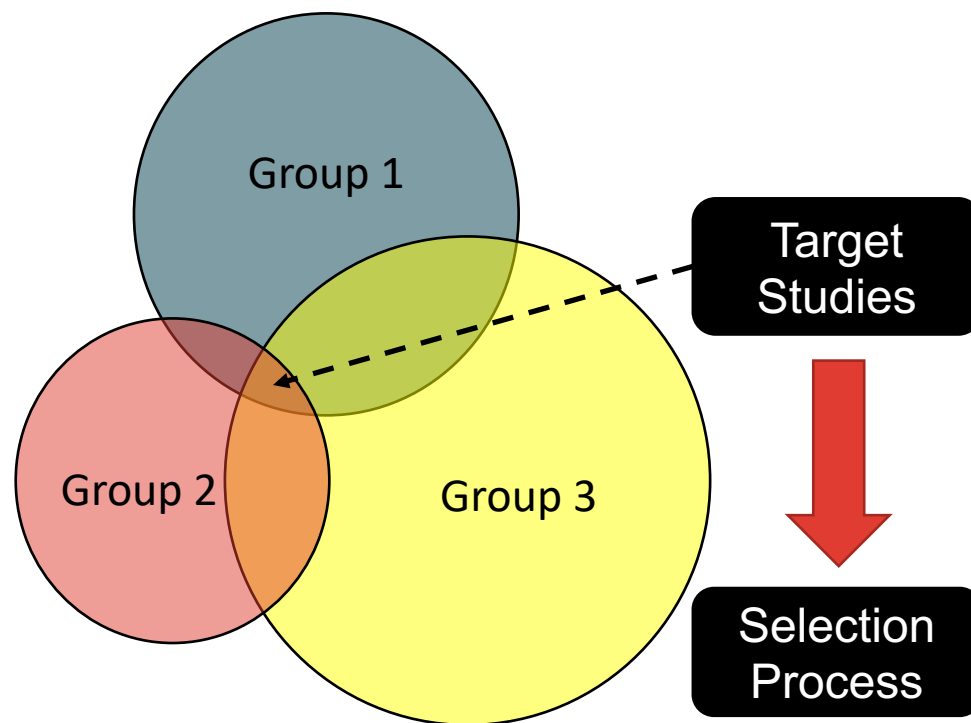10. Draw critical conclusions and refine research hypotheses

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reporting

- Implement the search strategy by

- applying OR operator within the groups and AND operator between the groups.

- The primary goal is to find the literature that is the intersection of the sets

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Group 1

Group 2

Group 3

Target Studies

Selection Process

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- Identify those primary studies that provide direct evidence

- Decided during the protocol definition and refined during the search process

- Inclusion and exclusion criteria should be based on the research question

- General removal criteria:

    - Duplicates (keep the highest ranking source)

    - The same study published in different sources (keep the highest ranking source)

    - Studies published before a certain date (or even after).

- Inclusion criteria define the characteristics that studies must have in order to be considered relevant to the review, such as specific populations, interventions, or outcome measures.

- Exclusion criteria define the characteristics that make a study ineligible for inclusion, such as studies that lack a control group or those that are duplicates of other studies.

- To ensure that the review is focused, relevant, and rigorous.

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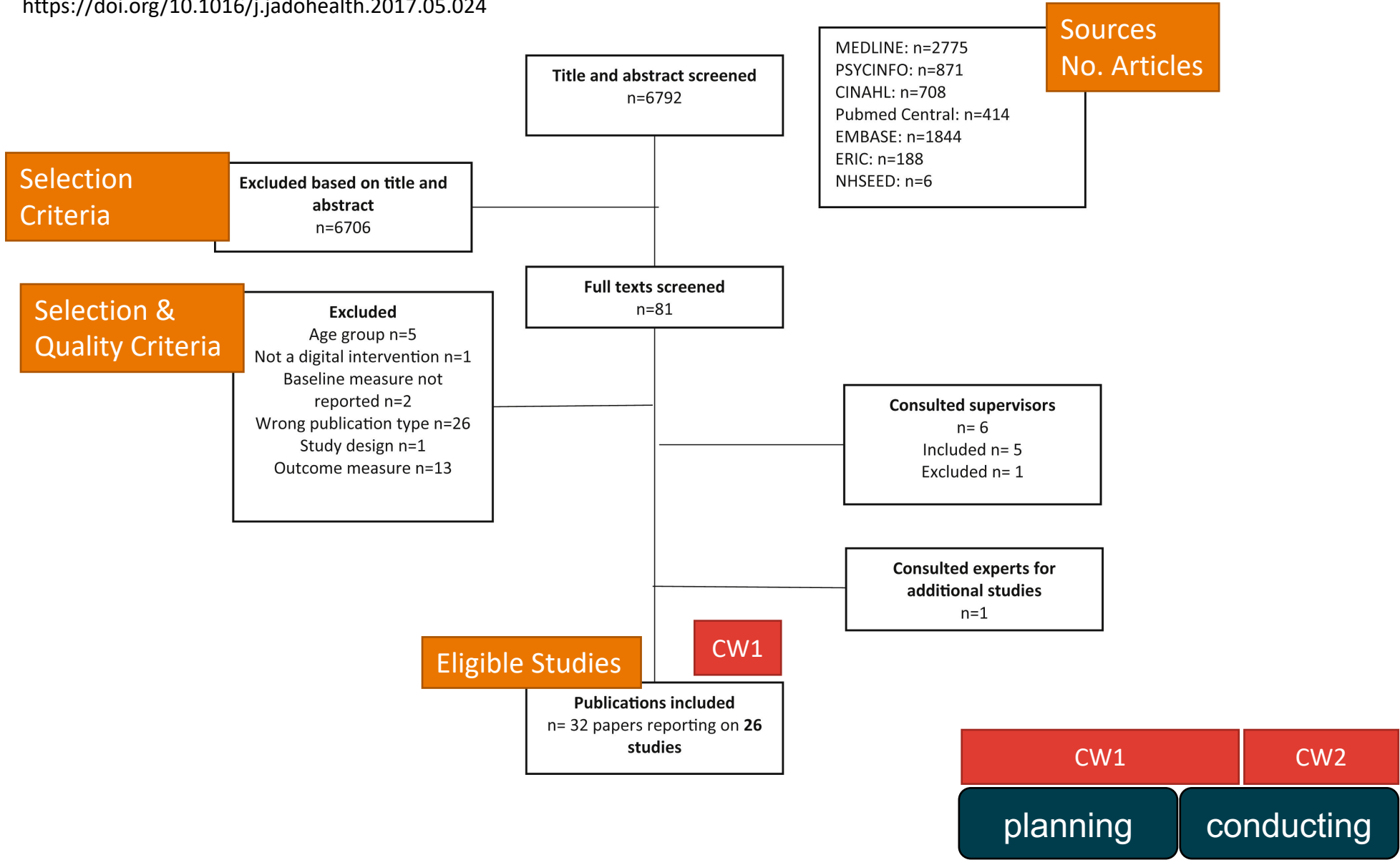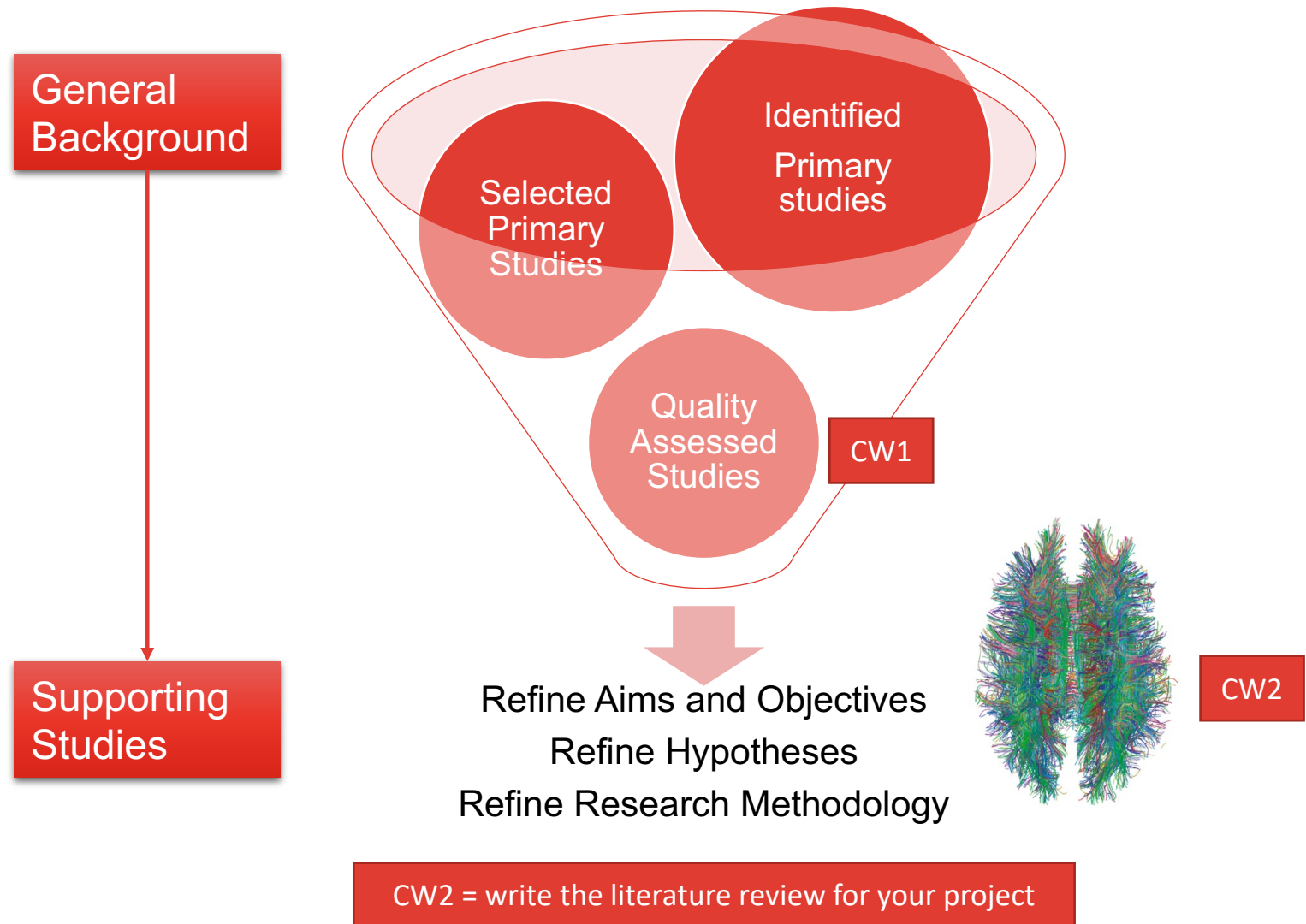10. Draw critical conclusions and refine research hypotheses

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"A Systematic Review of Digital Interventions for Improving the Diet and Physical Activity Behaviors of Adolescents"
https://doi.org/10.1016/j.jadohealth.2017.05.024

Sources No. Articles

MEDLINE: n=2775
PSYCINFO: n=871
CINAHL: n=708
Pubmed Central: n=414
EMBASE: n=1844
ERIC: n=188
NHSEED: n=6

Title and abstract screened
n=6792

Selection Criteria

Excluded based on title and abstract
n=6706

Full texts screened
n=81

Selection & Quality Criteria

Excluded
Age group n=5
Not a digital intervention n=1
Baseline measure not reported n=2
Wrong publication type n=26
Study design n=1
Outcome measure n=13

Consulted supervisors
n= 6
Included n= 5
Excluded n= 1

Consulted experts for additional studies
n=1

Eligible Studies

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Publications included
n= 32 papers reporting on **26 studies**

CW1	CW2
planning	conducting

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- Design data extraction tables to record the information obtained from the primary studies.

- Must be designed to collect all the information needed to address the review questions.

- Concurrent with data extraction quality assessment is applied in more detail to each study.

- In most cases, data extraction will define a set of numerical values that should be extracted for each study (e.g. number of subjects, treatment effect, confidence intervals, etc.).

- Numerical data are important for any attempt to summarise the results of a set of primary studies and are a prerequisite for meta-analysis

- To be used to assess the quality of the AI/ML models, compare the results across studies, and synthesize the findings of the systematic review.

- Tables can be adapted or expanded based on the specific research question and type of data being analysed.

CW2

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Study Identification	• Author – Title – Journal – Year – Reference – Source
Study Characteristics	• Study design • Population • Sample size
Study Data & Methods	• Data source (type and number of samples) • Data pre-processing techniques • Handling of missing data • AI/ML model type and architecture • Data partitioning method (training, validation, test) • Evaluation metrics (accuracy, F1-score, AUC, etc.) • Hyperparameter tuning method • Feature selection method

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Study Results	
	• Evaluation of generalizability to new populations or data
	• Evaluation of stability and consistency of the model over time
	• Interpretability analysis (feature importance, decision trees, etc.)
	• Confidence intervals or p-values
	• Robustness to out-of-sample data
	• Bias and fairness analysis
	• Scalability of the model
	• Comparison with traditional machine learning models

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Study Discussion & Conclusions	• <u>Study limitations</u>: of the study design, methods, and results
	   • that may affect the validity and generalizability of the findings.
	
	• <u>Implications for practice or policy</u>: potential applications or benefits of findings.
	
	• <u>Comparison with previous studies</u>:
	   • highlighting similarities and differences and
	   • addressing potential sources of variability.
	
	• <u>Strengths and weaknesses</u>: of the study design, methods, and results
	   • highlighting areas for improvement in future research - challenges
	
	• <u>Recommendations for future research</u>
	
	• <u>Implications of the study results for the study hypothesis</u>:
	   • whether the results support or refute the hypothesis
	   • and the level of confidence in the findings.

- Data synthesis involves collating and summarising the results of the included studies

- Synthesis of descriptive or non-quantitative characteristics.

- Synthesis of quantitative data from the studies using comparable metrics.

- When quantitative results have been tabulated summarize using forest plots

- Annotate forest plots to identify high quality primary studies

- Rank forest plots in decreasing order of quality or in decreasing study type hierarchy order.

- Explicitly identify on the forest plot studies with issues about the data extracted.

- Impact excluding poor quality studies or studies of a particular type would have on conclusions

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- There is no one "best" criteria to assess AI models.

- The criteria will depend on the specific research question and type of data being analysed.

- Performance: metrics such as accuracy, precision, recall, F1-score, AUC, etc., that measure the ability of the model to correctly classify or predict outcomes.

- Robustness: evaluation of the stability and consistency of the model over time, and its ability to generalize to new populations or data.

- Bias and fairness: assessment of the potential for bias in the model and its ability to produce fair and unbiased results, in particular where there is a risk of discrimination.

- Interpretability: evaluation of the ability to understand and interpret the model's results, analysis of feature importance, decision trees, or other interpretability methods.

- Scalability: assessment of the ability of the model to scale to larger datasets or handle increasing computational demands.

- Consider a combination of these criteria to obtain a comprehensive assessment.

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- Use the synthetised data to draw critical conclusions that refine the hypothesis of the project

- Consider the strengths and weaknesses of the studies, the consistency of the results, the

  implications for practice or policy, and the implications for future research.

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- It is the objective of Coursework 2

- Should be based on a thorough and critical analysis of the eligible synthesized data.

- Should include a discussion of the strengths and limitations of the review.

CW2

- Aims to be a a critical section shaping your final dissertation where you will iteratively refine it.

- It will become important material for the background and introduction sections.

  - Background section:

    - Provides context and background information on the topic of the thesis.

    - Broad understanding of the field and the current state of research.

    - Provides the context in which the research question is being studied.

  - Introduction section:

    - Provides a focused overview of the research question.

    - Clear and concise statement of the aims and objectives of the study.

    - It should explain the significance and importance of the study.

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