RESEARCH MODULE

INTRODUCTION
What and How

Objective: Students have capability to implement a proper research that meets the expected standards

Three stages of Research Module:
- Introduction to research (2 weeks)
- Development of research proposal (semester 2-6 @ 2 hours/module)
- Research implementation and reporting (semester 2-6 or intensively in semester 9 for four weeks)
General objective:
Students have capability to implement a proper research that meets the expected standards to be able to solve medical/health problems through research (problem solving cycle)
Objectives

Specific objectives:

- Able to identify problem
- Able to organize problem solving
- Able to implement and evaluate results
Stage-1

Aims:

- Able to demonstrate competence in biostatistics and epidemiology in order to explain medical/health problem related to basic, clinical, community sciences
- Able to develop a research proposal to answer or solve the problem
Stage-1

- **General Objective:**
  - Able to understand the role of research in solving health problem

- **Specific Objectives:**
  - If provided with health problem, able to study and construct an appropriate and rational frame of research concept (trigger-1)
  - If provided with health problem, able to design a complete research proposal (trigger-2)
Stage-1

- Scope and topics:
  - Introduction:
    - Research in medical science (implication, role and background)
    - Research proposal (research cycle)
  - Methods:
    - Research design
    - Statistics
  - References:
    - Literature search
    - Writing references
Stage-1

- Teaching method:
  - Orientation (lecture, group discussion, individual activities, literature search and statistic exercises – 2 weeks)
  - Practice (group presentation – 2 plenary)
  - Feed back (student notebook-10%, group discussion evaluation-10%, group assignment-10%, formative and summative exams-20%, individual proposal-50%)
Stage-1

- **Group Discussion 1:**
  - Identify the health problem in the trigger-1
  - Formulate research question(s)
  - Make a complete research proposal (using available form)
  - List information needed to conduct the research

- **Group Discussion 2:**
  - Data collection or by using trigger-2
  - Data analysis and interpretation (statistics)
  - Report writing
Stage-1

Student Notebook:
- Data
- Problem identification
- List of questions
- Hypothesis
- Plenary results
REFERENCES (textbooks):
- Basic and clinical biostatistics (2004)
- Medical epidemiology (2005)
- Statistics in medicine (2006)
- Epidemiology in medicine
- Metodologi penelitian bidang kedokteran (1985)
- Dasar2 metodologi penelitian klinis (2000)
- Foundation of clinical research, application to practice (2000)
- Introduction to medical statistics (1988)
- Interpretation and uses of medical statistics (1991)
What to do in stage-2

- Find a topic
- Find a group
- Find a supervisor
- Writing your proposal
- Approval from your supervisor
- Report and hand your proposal to the Research Module Team
- Conduct data collection and data analysis
- Writing your report
- Approval from your supervisor
- Report and hand your report to the Research Module Team
- Ready for examination (Phase-3)
What to do in stage-2

- Find a topic:
  - By reading articles
  - From the on going module:
    - Cell and genetics
    - Molecular biology
    - Neuroscience
    - Growth and development
  - Own interest on specific topic:
    - Microbiology
    - Nutrition
    - Pediatrics or others
What to do in stage-2

- Find a group:
  - 3-6 students

- Find a supervisor:
  - Related to the topic of interest

- Writing your proposal:
  - Under supervision from your supervisor

- Approval from your supervisor

- Report and hand your proposal to the Research Module Team
  - To DR. Erni (Dept of Pharmacy)

- Conduct data collection and data analysis:
  - Primary or secondary data
What to do in stage-3

- Writing your report:
  - Introduction
  - Literature Review
  - Methods
  - Results and Discussions
  - Conclusions and Recommendations
  - List of References
- Approval from your supervisor
- Report and hand your report to the Research Module Team
- Ready for examination – hopefully before departing to Australia
Who to contact?

- Prof. DR. Dr. Rianto Setiabudy, SpFK (dept of pharmacology)
- Prof. DR. Dr. Sri Bekti, MS (dept of Physiology)
- Prof. DR. Dr. Rahayuningsih, SpPK (dept of clinical pathology)
- DR. Dr. Saptawati Bardosono, MSc (dept of nutrition)
- DR. Dr. Ernie Purwaningsih, MS (dept of pharmacy)
- Dr. T Mirawati Sudiro, PhD, SpMK (dept of microbiology)
- Dr. Nurhadi Ibrahim, PhD (dept of physiology)
- Dr. Elisna Syahrudin, PhD, SpP (dept of pulmonology)
- Beti Ernawati, SSi, PhD (dept of microbiology)
- Dr. Zarni Amri, MPH (dept of community medicine)
- Dra. Ary Estuningsih, MS (dept of pharmacology)
INTRODUCTION TO RESEARCH
SAPTAWATI BARDOSONO
WHAT IS RESEARCH?

- Research is a process that seeks, finds, and transfer new knowledge
- Research (Webster’s dictionary of the English language) is a studious inquiry or examination, especially a critical and exhaustive investigation or experimentation having for its aim:
  - the discovery of new facts and their correct interpretation,
  - the revision of accepted conclusions, theories, or laws in the light of newly discovered facts or the practical application or such conclusions, theories, or laws
SCIENTIFIC METHOD

HYPOTHESIS → EXPERIMENTATION → INTERPRETATION → RESULTS/CONCLUSION → THEORY
SCIENTIFIC METHOD

• The research purpose of problem:
  ○ Expresses the question to be answered of the problem to be solved

• The hypothesis:
  ○ A prediction of the outcome of the research that will follow and therefore a solution of the problem or an answer to the question

• Experimentation:
  ○ The conducting of the research itself using one of the many methodologies available to the researcher
SCIENTIFIC METHOD

- Interpretation or analysis:
  - Interpreting the data collected from the experimentation so as to understand what it means

- Conclusion:
  - Answers the originally posed question, and confirms or disproves the hypothesis

- Theory formulation:
  - A statement founded on the conclusion
EXAMPLE OF SCIENTIFIC METHOD APPLICATION

Antoine Lavoisier:

- Using Priestley’s earlier discovery that oxygen is involved in burning, he formulated the hypothesis that respiration in animals was a form of combustion.
- He carried out experimentation under controlled conditions on animals (guinea pig). Oxygen consumption, heat production, and production of carbon dioxide by animals confined in airtight chambers were carefully measured.
EXAMPLE OF SCIENTIFIC METHOD APPLICATION

- From the measurements (data) collected, he interpreted the results: a pattern could be identified between oxygen consumption, carbon dioxide production, and heat emanating from the animal body.

- Based on his interpretation of the data, he formulated the theory that consumption of oxygen is related to the amount of carbon burned or heat produced in the animal body. Then to validate his theory, he performed similar controlled experiments on other animals, including humans.
RESEARCH METHODOLOGIES

• Basic research:
  ○ seeks to expand existing knowledge by discovering new knowledge

• Applied research:
  ○ seeks to solve problems primarily in the field setting
RESEARCH METHODOLOGIES

- According to strategy:
  - Historical
  - Survey

- According to degree of experimental control:
  - Experimental
  - Non-experimental

- According to time dimension:
  - Cross-sectional
  - Longitudinal

- According to setting:
  - Laboratory
  - Field

- According to purpose:
  - Descriptive
  - Analytical
RESEARCH METHODOLOGIES

• Qualitative method:
  ○ If the data are verbal
  ○ Historical and descriptive survey methods

• Quantitative method:
  ○ If the data are expressed in numbers
  ○ Analytical survey and experimental methods
HISTORICAL METHOD

- Seeks to explain the cause of past events and to interpret current happening on the basis of these findings.
- Source of information are primarily documentary in the form of:
  - Written records and accounts if past events
  - Literary production and critical writing
- Relies only on primary data
- Does not need to be analyzed by any form of statistical treatment or data analysis.
DESCRIPTIVE SURVEY METHOD

- Observes across a defined population group, whatever variable is under study:
  - Physical (size, shape, color, strength, etc.)
  - Cognitive (achievement, beliefs, attitudes, intelligence)

- Observation tools:
  - Visual perception
  - Questionnaires
  - Attitude scales
  - Inventories
  - Other evaluation measures

- Carefully records what was observed for future interpretation
CASE REPORT METHOD

- Report of observations on one subject:
  - Symptomatology
  - Treatment
  - Conclusions
  - Recommendations
  as they apply to a patient under study

- Useful in attempts to identify variables or generate hypotheses that may be important in the etiology, care, or outcome of patients with a particular disease or condition

- Case series, involves observation on more than one subjects having a condition or disease in common
ANALYTICAL SURVEY METHOD

- Uses language not of words but of numbers (values obtained are numerical)
- Analyzed by statistical tools from which conclusions can be inferred (descriptive statistics):
  - Measures of central tendency (mean, median, mode)
  - Measures of dispersion (range, standard deviation, coefficient of variation), or
  - Measures of correlation (correlation coefficient, regression analysis)
Inferential statistics, has 2 principal functions:

○ To predict or estimate from a random sample a certain parameter in a general population
○ To test the null hypothesis based on statistics
ANALYTICAL SURVEY METHOD

- Observational designs may take the form of epidemiological or cohort studies:
  - A cohort is a group of subjects entered into a study at the same time and followed up at intervals over a period of time
  - Also called a prospective study (looking ahead):
    - Seven countries studies on CHD
    - Framingham study on CHD
    - Nurses’ health study on cancer and CVD
EXPERIMENTAL METHOD

- Based on cause and effect
- Allow the investigator to control or manipulate one or more variables in an effort to examine the relationship between the variables (dependent and independent)

Design:
- Control group – experimental group design
- Pretest-postest design

Statistical analysis:
- Descriptive
- Inferential
Lipid research clinics coronary primary prevention trial (LRC-CPPT):

- To determine whether reducing blood cholesterol levels lowers the risk of CHD in humans
- Study population consisted of people known to be at risk for CHD
- Subjects were randomly selected to receive either the drug or a placebo – double blind
- Results showed that the drug group experienced a 19% reduction in the risk of the primary end point, and a 1% reduction in blood cholesterol level yields approximately a 2% reduction in CHD rates
Descriptive terms that reflect the effectiveness or quality of a research effort include:

- **Validity**, effectiveness of the measuring instrument.
- **Accuracy**, is expressed as the difference between the measured values of an instrument and the true values.
- **Reliability**, refers to the instrument used in the study and indicates the degree of accuracy that it generates.
- **Precision**, is a very useful expression of the consistency or repeatability of multiple analyses performed in the same sample or subject.
INITIATION OF RESEARCH

Four steps should be followed:

1. Select the research topic or problem to be solved:
   • A review of published literature in relation to the selected research topic is necessary in order to have a basis on which to build present research and precisely define the research
INITIATION OF RESEARCH

Four steps should be followed:

2. Clearly state the question to be researched:

   Components of the question include:
   - who/which (subjects or units being assessed are identified),
   - what (the factor or interest is stated specifically), and
   - how assessed (the outcome to be assessed is stated specifically)
INITIATION OF RESEARCH

Four steps should be followed:

3. Prepare a research plan/proposal, include:
   ○ A statement of the research question
   ○ A review of literature
   ○ The significance of the research
   ○ A description of research design, which should specify the specifics of the investigation (methods, data analysis, and the appropriate statistical analysis)
INITIATION OF RESEARCH

Four steps should be followed:

4. Plan for the collection and preparation of data:
   ○ Collection of data
   ○ Interpreting the data
   ○ Reporting the results
PROBLEMS IN RESEARCH

Insoluble problems:
- Lack of representative sampling
- Vague target population definition with poor selection of the subjects
- Lack of random allocation of treatments
- Lack of proper handling of confounding variables
- Lack of appropriate controls
- Lack of blinded subjects and evaluators
- Lack of objective measurement or assessment outcome
PROBLEMS IN RESEARCH

Soluble problems:

- Inadequate assurance of group comparability
- Inappropriate choice of sample units
- Use of calculated normal limits for skewed distribution; multiple significance testing
- Incorrect denominators for rates, risks, or probabilities
- Misuse and incorrect presentation of age data
- Improper handling of problems arising from incomplete follow-up in longitudinal studies
- Spurious associations between diseases or between a disease and apparent risk factors
- Ambiguity concerning descriptive statistics used
TO PREVENT PROBLEMS IN RESEARCH

- Is the central problem for research (and its subproblems) clearly stated?
- Does the research evidence plan and organized?
- Has the researcher stated the hypotheses?
- Are the hypotheses related to the principal problems or the subproblems of the research?
- Are the assumptions stated? Are the assumptions realistic for the research undertaken?
TO PREVENT PROBLEMS IN RESEARCH

- Is the research methodology that has been employed clearly stated?
- If the research is of experimental design, was it in vivo or in vitro work?
  - If in vivo, were humans or animals used?
  - Was there a control group?
  - What were the sex, number, and age of experimental (and control) subjects?
  - What was the length of the experiment?
  - Was there a sufficient number of subjects and/or sufficient time allowed to warrant meaningful conclusions?
TO PREVENT PROBLEMS IN RESEARCH

- Is the statistical treatment of data clearly defined and are statistics presented in a straightforward manner?
- Are the conclusions that the researcher presents justified by the facts presented?
- Is there any indication whether the hypotheses are supported or rejected?
- Are limitation of the study identified?
- Is there any reference to or discussion of related literature or studies by other investigators?
- Are specific areas for further research suggested?
- By whom was the research sponsored? Could results be influenced in any way by the source of funding?
EVALUATION OF RESEARCH AND SCIENTIFIC LITERATURE

- Library research paper cannot be considered research because it is not gathering new data or using existing data for a new purpose.
- It involves the selection and transfer of existing information and therefore requires careful evaluation if scientific literature.
- There is a form of research synthesis that attempts to solve research problems through literature reviews = meta-analysis.
META-ANALYSIS

- Problem to be studied has to be identified
- Definitive criteria are reported for the literature analysis
- The results included from the various studies are converted to a quantitative standard that allows the use of statistical techniques as a mean of analysis
Not original research but are summaries of research in a particular area (subject)
Based on information formerly published in refereed journals.
Lack of a quantitative standard and statistical analysis of the data from multiple published reports
Information is secondhand and may have become somewhat distorted because of imperfections inherent in communication
Can be extremely helpful in providing an overview of some particular topic