Assessment Tools Fund

for the discipline «Fundamentals of Critical Thinking: Evidence-Based Medicine»

Level of Higher Education

SPECIALTY

Field of Study

31.05.03 – Russian Federation, 560004 – Kyrgyz Republic Dentistry

(code and title of the field of training)

Qualification

General Medicine

2023

1. LIST OF COMPETENCIES, INDICATING STAGES OF THEIR FORMATION DURING THE PROCESS OF MASTERING THE DISCIPLINE

Competencies	Planned learning outcomes in the discipline, characterizing the stages of competencies formation	Types of assessment tools/ section code in this document
OK-1 - able and ready to analyze socially significant problems and processes, use the methods of natural sciences, mathematics and the humanities in various types of professional and social activities	**Know:** - methods of statistical data processing; - methods and approaches used in evidence-based medicine; - indicators of sensitivity, specificity, predictive value, likelihood ratio of diagnostic methods. - methods of systematic and critical analysis; - methods of developing an action strategy for identifying and solving a problem situation; - epidemiological indicators of speed, ratio, proportion (mortality, lethality, incidence, prevalence, etc.) - characterization and design of clinical trials depending on the purpose of the study and the subject of study.	**Block A, D** - reproductive level tasks - test;
	Ability: - formulate a clinical question (PICO) - apply methods of searching, collecting and processing information; - calculate epidemiological indicators of speed, ratio, proportion (mortality, survival, lethality, incidence, prevalence, survival, incidence, etc.) - calculate sensitivity, specificity, predictive value, likelihood ratio of diagnostic methods; - carry out critical analysis and synthesis of information obtained from different sources; - apply the methods of a systematic approach and critical analysis of problem situations; - calculate the odds ratio and relative risk of the studied phenomena; - develop a strategy of action, make specific decisions for its implementation - evaluate the quality of scientific publications using the IMRAD framework; - assess the quality of clinical leadership using AGREE tools.	**Block B, D** - reproductive level tasks - problems solving; - control work

	Skills: - critical analysis and synthesis of information; - methodology of systematic and critical analysis of problem situations; - skills of presenting an independent point of view, analysis and logical thinking, public speech, moral and ethical argumentation, discussions and round tables; - methods of setting a goal, determining ways to achieve it, developing action strategies; - skills of predicting undesirable effects, based on data from the analysis of clinical and laboratory- instrumental activities; - plan epidemiological studies with the ability to choose the most effective design to obtain reliable results	**Block C, D** - practice-oriented and/or research level assignments - report
OK-3 - is able and ready to collect, process and interpret, using modern information technologies, the data necessary to form judgments on relevant social, scientific and ethical problems	**Know:** - methods for searching for evidence in existing databases (PubMed, Embase, Cochrane etc.); - accessible databases of evidence; - operators and criteria used in international databases; - differences and practical relevance of using original research, systematic reviews and literature reviews - primary and secondary sources of evidence;	**Block A, D** - reproductive level tasks - test;
	Ability: - use the structure of a well-formulated clinical question to search for evidence-based information - search international databases - form conclusions based on systematic reviews of the literature - evaluate the reliability of the results of the study; - interpret the results of scientific research - formulate the goals and objectives of an epidemiological study.	**Block B, D** - reproductive level tasks - problems solving; - control work
	Skills: - planning an epidemiological study; - use of operators (OR, NOT, AND) in international databases; - searching for evidence-based information in existing databases (PubMed, Embase, Cochrane etc.);	**Block C, D** - practice-oriented and/or research level assignments - report

SLK-1 - able and ready to implement ethical, deontological and bioethical principles in professional activities	**Know:** - on informed consent, ethical and legal norms of clinical trials; - basic principles of Good Clinical Practice (GCP) - copyright rules and citation requirements for scientific publications	**Block A, D** - reproductive level tasks - test;
	Ability: - formulate and evaluate the main principles of Good Clinical Practice (GCP) - Determine the design of medical research, choose the most appropriate research method in relation to the chosen topic, put research safety first - evaluate scientific publications for compliance with the scientific publication structure (IMRAD)	**Block B, D** - reproductive level tasks - problems solving; - control work
	Skills: - put into practice the basic principles of Good Clinical Practice (GCP) - analyze the results of clinical and epidemiological studies - critically evaluate the quality of a scientific publication	**Block C, D** - practice-oriented and/or research level assignments - report
PC-26 - able and ready to use the regulatory documentation adopted in healthcare, as well as used in international practical medicine	**Know:** - requirements for the development of clinical guidelines; - basic principles of Good Clinical Practice (GCP) - scientific publication structure (IMRAD) - criteria for evaluating clinical guidelines	**Block A, D** - reproductive level tasks - test;
	Ability: - assess the quality of clinical guidance - use search criteria used in international databases - classify international databases according to the degree of evidence	**Block B, D** - reproductive level tasks - problems solving; - control work
	Skills: - use of international sites containing evidence-based information - use of international data - assessment of the quality of normative and directive documents	**Block C, D** - practice-oriented and/or research level assignments - report

APPENDIX 2

Course Flow Chart

"Evidence-Based Medicine"

6th-Year General Medicine

Name of the course modules according to the RPD (based on the number of CEs in the semester minus the CR (KP))	Control	Form of control	Minimum credit score	Maximum credit score	Monitoring schedule (week of semester)
Module 1					
1. Basic concepts of evidence-based medicine. Basic statistical methods.	Current control	Activity; attendance; participation in research projects; solving situational problems on survival analysis, case-control designs, and cohort studies.	7	15	8
	Border control	Test #1 on the topic "Basic Statistical Methods"	13	20	
Module 2					
2. Medical information search strategy	Current control	Activity; attendance; participation in research; solving situational problems on the strategy of searching for medical information on issues of therapy, prevention, diagnosis and prognosis, its critical evaluation; searching for clinical guidelines, critically evaluating the methodological quality of guidelines using the AGREE tool.	7	15	13
	Border control	Test No. 2 on critical assessment of the methodological quality of guidelines for the AGREE instrument.	13	20	
TOTAL for the semester			40	70	
Intermediate control (test with assessment) - test			20	30	14
Semester ranking by discipline			60	100	

3. STANDARD CONTROL TASKS AND OTHER MATERIALS NECESSARY FOR ASSESSING THE PLANNED LEARNING OUTCOMES IN THE DISCIPLINE (ASSESSMENT TOOLS)

Блок A, B, C, D

A. 1. Questions for Oral Examination

Topic 1. Basic Concepts of Evidence-Based Medicine

1. Definition of evidence-based medicine.
2. The main idea of evidence-based medicine.
3. The main concepts and tools of clinical epidemiology.
4. A typical example of clinical epidemiology. The Framingham Study.
5. Statistics and Medicine. The Kefauver–Harris Act.
6. What constitutes the highest level of evidence in the classical EBM pyramid?
7. (Randomized controlled trial / Systematic review and meta-analysis / Expert opinion / Case series)
8. What is the key difference between a randomized controlled trial (RCT) and a cohort study?
9. (Presence of a control group / Presence of an intervention / Random allocation of participants / Retrospective data collection)
10. What is a “patient-reported outcome”?
11. (Any blood test result / Patient’s own assessment of quality of life and symptoms / Physician’s opinion about treatment success / Drug side effect)
12. What is the clinical meaning of the p-value?
13. (Probability that the result is random / Magnitude of treatment effect / Percentage of cured patients / Level of trust in the study author)
14. Do you have access to full texts of international journals (through an institute, hospital, or independently)?
15. How much time per week are you willing to spend reading new medical articles?
16. Algorithm for article selection.

Stages of development and trials in EBM

1. At the preclinical research stage – application of international standards of Good Laboratory Practice (GLP);
2. At the clinical research stage – application of international standards of Good Clinical Practice (GCP);
3. When using biostatistics (during study planning, data processing and analysis) – application of international standards of Good Statistical Practice (GSP);
4. Five steps of EBM practice.

A.2. Questions for Midterm Assessment

Module 1. Basic methods of statistical processing of biomedical information.

Topic 1. Basic concepts of case-control study design

1. **Case definition**: What clear diagnostic criteria were used to determine that a person is a "case" (ill)? (Invasive vs non-invasive methods, histology vs MRI).
2. **Source of cases**: Where were the patients recruited from? (From a specific hospital, a national registry, an outpatient clinic?). If from a hospital — is there a risk of Berkson's bias, when hospitalized patients generally have more risk factors than the overall population?
3. **Source of controls**: Where were the healthy individuals selected from? (Neighbors, friends of cases, random sample from the population, patients from another hospital?).
4. **Validity of controls**: Is the control group representative? Does it reflect the population from which the cases theoretically arose? (For example, if cases are heavy smokers with lung cancer from an oncology center, controls cannot be recruited from a sanatorium for asthma treatment).
5. **Exclusion of disease in controls**: Did you ensure that people in the control group definitely do not have the disease under study? Were they subjected to the same diagnostic testing as the cases?
6. **Blinded interview**: Who conducted the interview and did the interviewer know whether the person was a "case" or a "control"? (If they knew, they could subconsciously ask leading questions).
7. **Recall bias**: What was the time period between diagnosis and interview? Could the cases recall past actions more carefully (or, conversely, more distortedly) than healthy individuals?
8. **Data objectification**: Did you attempt to confirm patients' statements with objective data (medical records, employment records, past population surveys), rather than interviews only?
9. **Time interval**: Was the "exposure" time window clearly defined? Was it ensured that the exposure (e.g., drug intake) occurred BEFORE disease symptoms appeared, and not after?

Topic 2. Basic concepts of cohort study design

1. **Cohort definition**: From which population were participants recruited? (General population, professional cohort (e.g., physicians), ecological zone). Is this sample representative of the population to which you intend to generalize conclusions?
2. **Exposure groups**: Are the comparison groups clearly defined (exposed and non-exposed)? Was it ensured that the non-exposed group was truly not exposed and comparable to the exposed group on all other baseline parameters?

3. **Inclusion/exclusion criteria**: Were all participants free of the studied outcome at baseline? (Important: if studying lung cancer, the cohort must not include cancer patients at enrollment).
4. **Baseline level**: Were data on potential confounders (age, sex, lifestyle, comorbidities) collected at baseline?
5. **Comparison of dropouts**: Was an analysis of participants lost to follow-up conducted? Did they differ from those who remained? (If mainly healthy or mainly ill participants dropped out — the result is biased).
6. **Outcome diagnosis**: How was the outcome identified? (Death — easy; development of depression — difficult). Were outcome criteria equally strict for both groups?
7. **Blinded outcome assessment**: Did the physician/researcher establishing the diagnosis (outcome) know to which exposure group the patient belonged? (If yes — hyperdiagnosis in the exposed group is possible).

Topic 3. Basic concepts of randomized controlled trial (RCT) design

1. **Sequence generation**: How was the random sequence generated? (Computer generator, random number tables vs date of birth, record number — the latter are poor methods).
2. **Allocation concealment**: Could the researcher enrolling a patient know in advance which group the next participant would enter?
   Good: centralized telephone allocation, sealed opaque envelopes.
   Poor: open list, unsealed envelopes.
3. **Baseline balance**: Was a "Baseline Characteristics" table provided? Are there significant differences between groups? (If $p < 0.05$ for an important variable — either failed randomization or small sample size). Who was blinded?
4. **Verification of blinding**: Was it checked at the end whether patients/physicians guessed their group assignment? (If they guessed — the blinding effect may have decreased).
5. **Similarity of interventions**: Were interventions maximally similar in appearance, taste, administration mode? (For tablets — placebo; for surgery — sham operations are difficult but possible).
6. **Primary outcome**: Is a single (or main) primary outcome clearly defined? (Risk — "switching horses midstream," when the primary outcome is changed at the end to the one that "worked").
7. **Secondary outcomes**: Were they pre-specified? (Or were multiple differences found post hoc, resembling "p-hacking"?).
8. **Clinical significance**: Is the primary outcome truly important for the patient? (Pain, death, quality of life) vs surrogate outcomes (blood sugar level, mmHg blood pressure — important, but not always life-saving).
9. **Time of assessment**: Was follow-up long enough for the outcome to manifest?

Module 2. Multivariate statistical methods for processing biomedical information.

Topic 1. Basic concepts of ROC analysis.

1. **Definition**: What is an ROC curve and what do its axes represent? (Y-axis: Sensitivity; X-axis: 1–Specificity (False Positive Rate)).
2. **Meaning of a point**: What does each point on the ROC curve represent? (Sensitivity and specificity at a specific cut-off threshold).
3. **Ideal test**: How does the ROC curve look for an ideal test? (Passes through the upper left corner: 0.1 on X-axis and 1.0 on Y-axis).
4. **Non-informative test**: How does the ROC curve look for a test operating at random guessing level? (Diagonal 45-degree line).
5. **Definition of AUC**: What is the area under the ROC curve (AUC – Area Under Curve)? Range of values: What values can AUC take? (From 0 to 1, where 0.5 — random guessing, >0.9 — excellent).
6. **Model comparison**: If Test A has AUC = 0.85 and Test B has AUC = 0.86, does this mean Test B is clinically significantly better? (No, confidence intervals must be examined and whether they overlap).
7. **Youden Index**: How to find the "optimal" cut-off using Youden's Index? (Maximize Sensitivity + Specificity − 1).
8. **Context dependence**: Is Youden's Index always the best way to choose a threshold? (No. Threshold depends on clinical context).
9. **Closest-to-(0,1) method**: Search for the point with minimal Euclidean distance to the upper left corner.
10. **AUC comparison**: How to statistically compare AUCs of two correlated ROC curves? (DeLong test). Comparison of sensitivity at fixed specificity.
11. **Confidence intervals**: Is it necessary to report 95% CI for AUC?

Модуль 2

Topic 2. Basic concepts of Survival Analysis and Cox Regression

1. **Survival function S(t):** The probability that a patient survives longer than time *t* (i.e., the event has not yet occurred). It decreases over time (from 1 to 0).
2. **Hazard function h(t):** The instantaneous rate (intensity) of event occurrence at time *t*, given that the patient has survived up to that moment. It may increase, decrease, or remain constant over time.
3. **Question 3: What is the Kaplan–Meier curve? Answer:** It is a nonparametric method for estimating the survival function. The curve has a "stepwise" appearance, with downward steps at each event time. It accounts for censored observations (usually marked by vertical tick marks on the curve).

4. **Question 4: How do we compare two survival curves (e.g., treatment and control groups)?**
   Answer: By using the log-rank test. It tests the hypothesis: "Is there a difference in survival between the groups?" It considers all time points but does not estimate the magnitude of the effect (hazard ratio).
5. **Question 5: What is the Hazard Ratio (HR)?**
   Answer: It is a measure of effect in Cox regression. HR indicates how many times the instantaneous risk of the event increases (or decreases) in one group compared to another.
   - HR = 1: Risks are equal.
   - HR > 1: Risk is higher in the exposed group (harmful factor).
   - HR < 1: Risk is lower in the exposed group (protective factor).
6. **Question 6: What is the equation of the Cox regression model?**
   Answer:

   $h(t|X) = h_0(t) \times \exp(b_1x_1 + b_2x_2 + ... + b_kx_k)$

   where:

   - $h(t|X)$ — hazard for a specific patient with characteristics X.
   - $h_0(t)$ — baseline hazard (the hazard when all predictors equal zero). The model does not require specifying its functional form (therefore it is "semi-parametric").
   - $\exp(b_1x_1 + ...)$ — the part that depends on predictors.

2. Key Assumption — Proportional Hazards

7. **Question 7: What is the main assumption of the Cox model?**
   Answer: The proportional hazards assumption. It states that the hazard ratio (HR) between any two groups remains constant over time.
   - Example: If HR for a drug = 0.5, this means the risk of death in the treatment group is always two times lower than in the control group — on day 1, day 100, and day 1000.
8. **Question 8: How can this assumption be tested?**
   Answer:
   1. Graphically: Plot log(-log S(t)) versus time. If the lines are parallel, the assumption holds.
   2. Statistically: Use a test based on scaled Schoenfeld residuals. If the p-value > 0.05, the assumption is not violated.

10. **Question 10: What is the difference between Cox regression and logistic regression in outcome analysis?**
    Answer:

- Logistic regression analyzes a binary outcome (event/no event) and ignores time to event. If 20% die in group A within one year and 20% die in group B

within 10 years, logistic regression would say “the same,” while Cox regression detects a difference in risk.

- Cox regression also accounts for when the event occurred.

11. **Question 11: How do we interpret the regression coefficient in the Cox model?**
    Answer: The coefficient b (beta) represents the change in the log hazard. In practice, we interpret exp(b) (HR).

- For a continuous variable (e.g., age): HR = 1.05 means that with each additional year of age, the risk of death increases by 5% at any given time point.

12. **Question 12: How do odds differ from probability?**
    Answer:

- **Probability (P):** Ranges from 0 to 1. (Number of events / Total number).
- **Odds:** Range from 0 to ∞. (Probability that the event occurs / Probability that the event does not occur).
  Formula: Odds = P / (1 − P)
- Example: If the probability of recovery = 0.8 (80%), then odds = 0.8 / 0.2 = 4. This means the odds of recovery are four times higher than the odds of not recovering.

13. **Question 13: What is the Odds Ratio (OR)?**
    Answer: It is the ratio of the odds of an event in one group to the odds in another group.

- OR = 1 — no effect.
- OR > 1 — factor increases the odds of the event.
- OR < 1 — factor decreases the odds of the event (protective factor).

14. **Question 14: What is the equation of logistic regression?**

$$\log(p / (1 - p)) = b_0 + b_1x_1 + b_2x_2 + ... + b_kx_k$$

15. **Question 15: How should OR for a continuous variable (e.g., age) be interpreted?**
    Answer: With each one-year increase in age, the odds of the event increase by exp(b) times (e.g., 1.05 times), assuming all other variables in the model remain constant.
16. **Question 16: What is a 95% confidence interval (CI) for OR and how is it interpreted?**
    Answer: If the CI for OR does not include 1, the effect is statistically significant ($p < 0.05$). The width of the interval reflects precision (the wider the interval, the smaller the sample size or the greater the variability).

17. **Question 17: What is the difference between OR and RR (relative risk), and why do we obtain OR in logistic regression? Answer:**

- RR (risk in group A / risk in group B) is more intuitive.
- OR is mathematically convenient because it can take any value from 0 to ∞ and is symmetric.
- When the outcome is rare (<10%), OR ≈ RR. When the outcome is common, OR may substantially overestimate the effect compared to RR, and this must be considered in interpretation.

When teaching this subject, one of the primary learning outcomes is the ability to formulate a research question. If a student is unable to formulate a task on a given topic for analysis in SPSS, the module or examination is discontinued. Tasks are formulated by the student based on their own terminology, understanding of the method, and specialty. Therefore, since task formulation is the most important assessment criterion, it is impossible to provide a fixed list of tasks.