Neuro[de]cision

Supporting medical students in making informed decisions for their neurosurgery residency pathways

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Manual for Neurosurgical Education Activities: Implementation, Assessment, and Enhancement

Executive Summary

This manual provides comprehensive guidelines for implementing, evaluating, and enhancing a series of innovative educational activities designed for senior medical students and candidates for neurosurgery residency. The program has been developed through collaborative efforts between Humanitas University (Italy), International Neuroscience Institute - Hannover GmbH (Germany), University of Belgrade (Serbia), and Lusíadas (Portugal).

The foundation of this educational initiative rests on a robust, evidence-based approach to curriculum development. Rather than relying solely on traditional teaching paradigms, this program was built from the ground up through structured codesign sessions that captured the perspectives of both learners and educators. The result is a curriculum that addresses the identified gaps in conventional medical education regarding neurosurgical training.

The Codesign Process

The codesign methodology employed in developing this program represents a participatory approach to curriculum development where all stakeholders contribute to the educational design. This process was structured as follows:

Structure and Implementation

The codesign sessions were organized by Belgrade University and implemented across all partner institutions. The process included:

1. **Review of Current Programs**: Analysis of existing medical student curricula, learning methods, and available educational materials.
2. **Three-Session Structure**:

    - **First Session**: Conducted with students to understand their expectations for course content.
    - **Second Session**: Involved teachers and residency tutors to gather their perspectives on content and optimal teaching methodologies.
    - **Third Session**: Combined students and teachers to collectively define learning outcomes for the program.
3. **Data Collection and Analysis**: Belgrade University collected and analyzed data from all participating centers, prepared a comprehensive report, and shared findings among partners to inform the course structure.
4. **Objective Assessment**: Humanitas University developed an online survey centered on the question: "What can be improved in the medical course to have a better choice of the future specialty school in Neurosurgery?" The survey was distributed across all partner institutions, with results compiled for both quantitative measurement and qualitative reporting.

Key Findings

The codesign sessions revealed consistent priorities across all participating institutions. Students and educators identified the following needs, ranked in order of importance:

1. More exposure to neurosurgery including clinical activities
2. Development of practical skills
3. Awareness of the practical work done by a neurosurgeon
4. Understanding of a typical day (shifts, time in operating theater, emergency response)
5. Awareness of interdisciplinary teamwork and knowledge requirements
6. Enhancement of theoretical knowledge

Program Development

Based on these findings, the manual outlines an educational program with:

- Increased student enrollment (up to 20 students per institution)
- A macro-design focused on balanced participation, appropriate duration, and task distribution
- Integration of both practical skills development and theoretical knowledge
- Specific assessment methodologies aligned with learning objectives

The program is undergoing peer review by experts in both neurosurgery and education, with final validation planned during an annual neurosurgery meeting. The Delphi Method will be employed for the evaluation process to ensure rigorous assessment.

This manual serves as a guide to implement this carefully designed educational program, providing the tools and frameworks necessary to enhance neurosurgical education at any institution.

Each activity is meticulously outlined with specific implementation protocols, assessment methodologies, and continuous improvement strategies. The educational design follows a three-pillar evaluation approach: pre-testing, post-testing with statistical analysis of knowledge improvement, and qualitative surveys measuring emotional impact and participant satisfaction.

Table of Contents

1. Introduction

This manual outlines a comprehensive educational program designed to enhance the training and preparedness of neurosurgery candidates. The program consists of seven distinct educational activities that complement each other to provide a well-rounded educational experience focusing on technical skills, theoretical knowledge, and emotional preparedness for the demands of neurosurgery.

Program Objectives

- Enhance technical neurosurgical skills through hands-on practice
- Deepen understanding of neuroanatomy and surgical approaches
- Improve decision-making abilities in complex neurosurgical scenarios
- Prepare candidates for the psychological and emotional demands of the field
- Foster international collaboration and knowledge exchange
- Provide standardized assessment of educational impact

Consortium Partners

- **Humanitas University (HUNIMED), Italy**: Coordination and implementation of simulation activities

- **International Neuroscience Institute - Hannover GmbH (INI), Germany**: Leading cadaver lab workshops and technical skills training
- **University of Belgrade, Serbia**: Development of multimedia educational content and lecture series
- **Lusíadas, Portugal**: Management of international rotations and simulation programs

2. Brainwave: An Immersive Neurosurgical Skills Challenge – A High-fidelity Simulation Activity

Description

Brainwave is an intensive, hands-on skills challenge that integrates multiple clinical scenarios to test and develop fundamental clinical and neurosurgical skills. This advanced simulation experience utilizes state-of-the-art technology to recreate complex neurosurgical scenarios with exceptional anatomical accuracy and haptic feedback, allowing participants to practice critical procedures in a risk-free environment. Participants rotate through different clinical scenarios proposed focusing on specific technical skills, non-technical skills and receiving immediate feedback and coaching.

Implementation Guidelines

Required Resources

- High-fidelity Simulation Rooms
- Mixt Reality Technology
- Basic neurosurgical instrument sets
- High-definition recording and audio-video share equipment (CAE)
- Expert facilitators
- Briefing and debriefing room

Activity Structure

1. **Orientation Phase -Briefing** (60 minutes)
    - Introduction to high-fidelity simulation and objectives

    - Safety briefing and equipment familiarization
    - Pre-test administration
2. **Clinical Scenarios Rotation** (4 hours)
    - Each participant participates in different clinical scenarios
    - 30-40 minutes per scenario
    - Management of simulated complications
    - Decision-making under pressure
    - Multiple approaches to the same pathology
    - Immediate feedback from facilitators
3. **Integration Challenge** (1 hour)
    - Complex scenario requiring integration of multiple skills
    - Team-based approach to problem-solving
    - Real-time performance feedback
4. **Debriefing Session** (90 minutes)
    - Group discussion of challenges and learnings
    - Individual and team feedback on performance
    - Post-test and survey administration

Assessment Protocol

Pre-test Components

- Technical skills baseline assessment using standardized rating scales
- Knowledge assessment through multiple-choice examination
- Self-assessment of confidence and non-technical skills in specific procedures

Post-test Components

- Identical questions as to the ones in the Pre-test assessment

Emotional Impact and Satisfaction Survey

- 5-point Likert scale questions assessing:
    - Perceived educational value
    - Clarity of instruction
    - Psychological safety of learning environment
    - Impact on confidence and motivation
    - Open-ended questions for qualitative feedback
    - Suggestions for improvement

3. Cadaver Lab Workshop

Description

The cadaver lab workshop provides irreplaceable hands-on experience with human anatomy through carefully prepared specimens. This activity focuses on anatomical relationships, surgical approaches, and technique refinement under expert guidance.

Implementation Guidelines

Required Resources

- Fully equipped cadaver laboratory
- Fresh or specially prepared cadaver specimens (1 per 2-3 participants)
- Complete neurosurgical instrument sets
- Operating headlights
- Specialized drilling and dissection tools
- 2-3 expert neurosurgical instructors
- Laboratory technicians

Activity Structure

1. **Anatomical Orientation** (1 hour)

    - Detailed review of relevant neuroanatomy
    - Approach planning and rationale
    - Pre-test administration
2. **Basic Approach Demonstration** (1 hour)
    - Expert-led demonstration of key approaches
    - Step-by-step technique explanation
    - Critical landmark identification
3. **Hands-on Practice** (3 hours)
    - Participant-performed dissections and approaches
    - Individualized coaching and feedback
    - Progressive complexity of tasks
4. **Review and Integration** (2 hours)
    - Specimen review and discussion
    - Clinical correlation of anatomical findings
    - Post-test and survey administration

Assessment Protocol

Pre-test Components

- Anatomical knowledge assessment
- Approach planning exercise
- Self-assessment of confidence in anatomical understanding

Post-test Components

- Anatomical knowledge assessment
- Approach execution and technique assessment
- Self-assessment of anatomical confidence

Emotional Impact and Satisfaction Survey

- Psychological impact of working with cadaveric specimens
- Respect for donors and ethical considerations
- Perceived value of cadaveric versus simulated training
- Anatomical insight gains and application to clinical work

4. Clearing the Fog: An Immersive Look at Neurosurgery's

Description

This unique program addresses the psychological and emotional demands of neurosurgery through immersive experiences, case studies, and mentorship. The activity illustrates candidates on the stress, decision-making pressure, and emotional toll of the specialty.
This comprehensive program leverages diverse media formats to deliver an engaging educational experience over several weeks. Combining digital content, interactive modules, and collaborative projects, this activity allows for flexible, self-paced learning of complex neurosurgical concepts.

Implementation Guidelines

Required Resources

- Private spaces for reflection and discussion
- Experienced neurosurgeons willing to share personal experiences
- Comfortable environment conducive to open discussion

Activity Structure

1. **Understanding Neurosurgical Stress** (1 hour)
    - Briefing on the proposed activities
    - Definition of goals
    - Share of the proposed material:
        - **Do not harm Stories of Life, Death and Brain Surgery**
          Amazon
          English version https://www.amazon.it/Do-No-Harm-Stories-Surgery-ebook/dp/B00FYUM52C
          Italian version https://www.amazon.it/Primo-nuocere-Storie-morte-neurochirurgia/dp/8850247370

- **Concussion** (2015)
  Prime Video
  https://www.primevideo.com/detail/0NQ3099B6X94L5FIYRK2SPAA7D/ref=atv_dl_rdr?tag=justitnhhb-21
  Netflix
  https://www.netflix.com/it/title/80064511?source=35

- **Gifted hands** (2010)
  Prime
  https://www.primevideo.com/dp/amzn1.dv.gti.885065f2-4cb3-4d53-b7fe-a6c61d091487?autoplay=0&ref_=atv_cf_strg_wb
  Apple TV
  https://tv.apple.com/it/movie/gifted-hands/umc.cmc.72d7woqh65c3cuvex05cup8ch?action=play

- **The surgeon's cut (Dr. Q)** (2020)
  Netflix
  https://www.netflix.com/it-en/title/81004466

- **Link to questionnaire** Clearing the Fog: An Immersive Look at Neurosurgery's Demands. A Multimedia Experience
  https://forms.gle/vVZ9BWAqtYcTBPm26

2. **Immersive Activities** (self-paced, approximately one month)
    - Through guided readings and film viewings, students will directly confront the daily experiences, quality of life challenges, and personal tolls faced by neurosurgeons and residents in this extremely intensive specialty.
3. **Debriefing**
    - Group in presence and remote debriefing with experts focusing on non-technical skills, difficulties and challenges of the neurosurgery path and lifestyle of neurosurgeons.
    - Analysis of every single source proposed.

Assessment Protocol

Emotional Impact and Satisfaction Survey

- Perceived change in emotional preparedness
- Quality of personal insights gained
- Value of vulnerability and shared experiences
- Support in choosing neurosurgery as a residency

5.Frontal Lectures on Core Neurosurgery Topics

Description

This structured lecture series delivers foundational and advanced neurosurgical knowledge through expert presentations, case discussions, and interactive learning. The curriculum covers essential topics with evidence-based content and clinical correlations. The lectures can be followed by in presence, online or blended modality.

Implementation Guidelines

Required Resources

- Lecture hall with multimedia capabilities
- Case materials and imaging libraries
- Audience response system for interactive elements
- Expert lecturers with teaching experience
- Teaching assistants for discussion facilitation

Activity Structure

1. **Curriculum Overview** (1 session)
    - Introduction to lecture series structure
    - Learning objectives and expectations
    - Pre-test administration for each different topic approached during the lectures
2. **Core Topics Series** (10-15 sessions)
    - 120-minute sessions per topic
    - Standard format: 120-minute lecture, 30-minute discussion
    - Recommended topics:
        - Neuroanatomy for surgeons
        - Neuroradiology interpretation
        - Neurosurgical pathophysiology

        - Surgical approaches by region
        - Trauma management principles
        - Peripheral Nerve Surgery
        - Oncological neurosurgery
        - Vascular neurosurgery
        - Functional neurosurgery
        - Pediatric considerations
        - Spinal interventions
        - Complication management
        - Virtual Reality in Neurosurgery
        - Emerging technologies
3. **Summary and Integration** (1 session)
    - Concept mapping and knowledge synthesis
    - Post-test and survey administration

Assessment Protocol

Pre-test Components

- Baseline knowledge assessment for each of the lecture topics
- Case-based decision-making scenarios
- Self-assessment of confidence in covered domains

Post-test Components

- Comprehensive knowledge assessment with parallel questions
- Clinical reasoning and decision-making evaluation
- Self-assessment of knowledge improvement

Emotional Impact and Satisfaction Survey

- Content relevance and clinical applicability

- Presenter effectiveness and engagement
- Discussion quality and participation value
- Knowledge retention strategies
- Suggestions for topic additions or modifications

6. Two-Week International Rotation Program

Description

This immersive international experience places residents in partner neurosurgical departments abroad, exposing them to different healthcare systems, techniques, and approaches. The rotation combines clinical observation, hands-on participation, and cultural exchange.

Selection Criteria for Neurosurgical Residency Mobility Program

Partner Guidelines

This document outlines the unified selection criteria for senior medical students applying for the neurosurgical residency mobility program across the four participating European neurosurgical centers under the current European grant framework.

Evaluation Components

1. Motivational Letter (25% of total evaluation)

- Must be submitted at the program's commencement
- Should detail the candidate's specific interest in neurosurgery
- Should outline their goals for the mobility program
- Should demonstrate understanding of the program's collaborative nature

2. Clinical Rotation Performance (25% of total evaluation)

- Active participation in local clinical activities
- Demonstration of clinical skills and knowledge
- Professional conduct and team interaction
- Evaluation by local supervisors
- Attendance record and punctuality

3. Participation in Proposed Activities (25% of total evaluation)

a) Brainwave: Simulation Neurosurgical Activity

- Attendance and engagement
- Performance in practical exercises
- Teamwork capabilities
- Technical skill development

b) "Clearing the Fog" Self-Conducted Activity

- Completion of assigned tasks
- Quality of submitted work
- Initiative and creativity
- Self-directed learning capabilities

4. Academic Performance (25% of total evaluation)

- Overall university curriculum grade point average
- Performance in neurology and neurosurgery-related courses
- Research activities (if applicable)
- Additional relevant certifications or training

Selection Process

1. Candidates must meet all minimum requirements set by their home institution
2. Each component will be scored on a scale of 1-10
3. Final scores will be weighted according to the percentages above
4. The **top 5 scoring students** from each center will be selected for mobility placement

Important Notes

- All evaluations must be documented and archived
- Selection decisions will be reviewed by representatives from all four partner centers
- In case of tied scores, the motivational letter score will be used as the tiebreaker

Timing

- All components must be completed and evaluated before mobility placement
- Selected candidates will receive detailed mobility instructions within 2 weeks of selection

These items serve as the official guideline for student selection and should be implemented consistently across all participating centers. Any modifications to these criteria must be approved by all partner centers.

Implementation Guidelines

Required Resources

- Organize the international institutions with the partners
- Housing arrangements and local transportation
- Clinical access and credential processing
- Cultural orientation materials
- Local mentors and program coordinators
- Communication strategies for remote support
- Travel and accommodation funding

Activity Structure

1. **Pre-departure Preparation** (1 month prior)
    - Cultural and healthcare system briefing
    - Objectives setting and learning plan development
    - Logistics and safety orientation
2. **Arrival and Orientation** (1 day)
    - Facility tour and introductions
    - Local protocols and expectations review
    - Meeting with assigned mentor
3. **Clinical Integration** (8-10 days)
    - Progressive involvement in clinical activities
    - Daily schedule:
        - Morning rounds and case discussions

        - Operating theater observation/participation
        - Afternoon specialized clinics or conferences
        - Evening reflection and social program
4. **Special Focus Activities** (2-3 days)
    - Participation in local educational events
    - Research collaboration opportunities
    - Specialized techniques observation
    - Healthcare system analysis
5. **Reflection and Integration** (1 day)
    - Experience synthesis discussion
    - Future collaboration planning
    - Survey administration

Assessment Protocol

Pre-test Components

- Technical skills baseline related to host specialties
- Self-assessment of international practice readiness

Post-test Components

- Technical knowledge gains from exposure
- Self-assessment of adaptability and global perspective

Emotional Impact and Satisfaction Survey

- Cultural immersion experience quality
- Professional relationship development
- Personal insight into the proposed experience
- Logistical experience and support adequacy
- Future international engagement intentions

7. Evaluation Framework

Standardized Assessment Approach

Most of the educational activities within this program follow a consistent three-pillar evaluation framework:

1. **Pre-testing** - Baseline measurement before participation
2. **Post-testing** - Outcome measurement after completion
3. **Impact Survey** - Qualitative assessment of experience

Assessment Tools Development Guidelines

Knowledge Assessments

- Develop questions at appropriate cognitive levels
- Create parallel test forms with equivalent difficulty
- Establish content validity through expert review
- Include both recall and application questions

Skills Assessments

- Utilize validated assessment tools where available
- Develop structured observation checklists
- Train evaluators to ensure reliability
- Document both process and outcome measures

Impact Surveys

- Develop consistent core questions across all activities
- Include activity-specific supplemental questions
- Use standardized Likert scales (5-point recommended)
- Balance quantitative ratings with qualitative feedback
- Address emotional, cognitive, and skill domains

- Include future improvement suggestions

Sample Assessment Questions

Pre/Post Knowledge Assessment (Sample Items)

1. A 45-year-old patient presents with sudden onset of severe headache and nuchal rigidity. CT scan shows diffuse subarachnoid hemorrhage. What is the most appropriate next step in management?
2. When performing a pterional approach, which muscle must be detached from the superior temporal line?
3. The superior petrosal sinus is located at the junction between: .....

Impact Survey (Sample Items)

1. This activity significantly improved my understanding of neurosurgical approaches. (1-Strongly Disagree to 5-Strongly Agree)
2. I feel more confident in my ability to manage neurosurgical complications after this activity. (1-Strongly Disagree to 5-Strongly Agree)
3. The emotional demands of neurosurgery were effectively addressed in this activity. (1-Strongly Disagree to 5-Strongly Agree)
4. What aspects of this activity had the greatest impact on your development as a neurosurgeon? (Open-ended)
5. How could this activity be improved for future participants? (Open-ended)

8. Data Analysis and Reporting

Statistical Analysis Methodology

Knowledge and Skills Assessment

- Paired t-tests for pre/post comparisons
- Analysis of variance for between-group comparisons

Survey Data Analysis

- Descriptive statistics for quantitative responses

- Analysis of qualitative feedback
- Cross-activity comparison of satisfaction metrics
- Correlation analysis between performance improvement and satisfaction

Reporting Templates that need to be available

Individual Activity Reports

- Executive summary of outcomes
- Participant demographics
- Pre/post metrics with statistical analysis
- Graphical representation of key findings
- Qualitative feedback themes
- Improvement recommendations
- Resource utilization

Comprehensive Program Report

- Overall program impact assessment
- Comparative analysis across activities
- Identification of highest-value interventions
- Cost-effectiveness analysis
- Strategic recommendations for program evolution

Continuous Improvement Protocol

- Review of all activity reports within 30 days of completion
- Partners feedback during an integration meeting
- Action plan development for identified improvements

- Implementation timeline for modifications
- Follow-up assessment plan for changes made

9. Continuous Improvement Protocol

Improvement Cycle

1. **Data Collection and Analysis**
    - Comprehensive review of all assessment data
    - Identification of strengths and weaknesses
    - Participant feedback prioritization
2. **Planning Improvement**
    - Partners input
    - Solution development workshop
    - Resource assessment for proposed changes
    - Implementation of future plans
3. **Implementation**
    - Phased introduction of changes
    - Staff training for modified activities
    - Documentation of changes
4. **Evaluation of Changes**
    - Targeted assessment of modified elements
    - Comparison with previous outcomes
    - Participant feedback on specific changes

Key Performance Indicators

- Knowledge gain percentage (pre/post tests)
- Technical skill improvement metrics
- Participant satisfaction scores

- Cost per educational outcome unit
- Instructor effectiveness ratings
- Activity completion rates
- International partner engagement
- Long-term career impact indicators

Quality Assurance Measures

- Expert review of all educational content
- Regular calibration of assessment tools
- Facilitator performance evaluation
- Participant safety monitoring
- Equipment maintenance and testing protocols