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**COMPUTATIONAL ETHICS IN TRANSPLANT MEDICINE:
A MULTI-FRAMEWORK ANALYSIS**

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Relevance. The persistent disparity between the demand for transplantable organs and their limited supply creates one of the most ethically complex dilemmas in modern public health. In the United States alone, over 100,000 candidates await transplantation, yet fewer than 40,000 procedures are performed annually, leading to thousands of preventable deaths each year. Traditional allocation systems, while grounded in established bioethical principles such as those proposed by Beauchamp and Childress, often struggle to operationalize multiple competing ethical frameworks simultaneously. The emergence of computational ethics offers a paradigm shift, enabling the formalization of principles like utilitarianism, justice theory, and communitarianism into quantifiable algorithms. However, the integration of such systems into clinical practice raises critical questions regarding algorithmic bias, transparency, and the irreplaceable role of human ethical judgment.

Aim: to analyze the architecture and ethical validity of a computational decision support system- the Transplant Ethics Navigator (TEN)-designed to integrate multiple ethical frameworks into transplant organ allocation, and to assess its potential to enhance consistency, transparency, and equity in clinical decision-making.

Materials and methods. This study is based on a comprehensive analysis of the technical documentation of the Transplant Ethics Navigator (TEN) Enterprise Edition. The system's architecture, data models, and algorithmic formulations were examined, focusing on the implementation of five core ethical frameworks: principlism (autonomy, beneficence, non-maleficence, justice), utilitarianism (life-years and QALYs gained), communitarianism (local priority and social ties), feminist ethics (power and marginalization indices), and casuistry (case-based reasoning). The study evaluated the mathematical formulations for match scoring, risk assessment (KDPI, MELD, LAS), and regulatory compliance checking against UNOS and CMS policies. Statistical validation methods for synthetic data generation and survival analysis (Kaplan-Meier, Cox regression) were also reviewed.

Results and their discussion. The TEN system successfully operationalizes abstract ethical principles into computable metrics. For instance, the principlism composite score averages normalized values for autonomy (advance directive status), beneficence (expected life-years gained), non-maleficence (surgical risk index), and justice (wait-time normalization). The utilitarian framework calculates expected benefit as life-years multiplied by quality-of-life weights and survival probability, while the feminist ethics module quantifies a marginalization index to identify intersectional vulnerability. The consensus algorithm reconciles these frameworks by calculating mean scores and standard deviations, flagging cases where frameworks disagree for human ethics committee review.

Conclusions. The Transplant Ethics Navigator represents a significant advancement in the application of computational ethics to clinical medicine. By providing a transparent, multi-perspective analysis of allocation decisions, it enhances consistency and documentation without eliminating human moral agency. The system's ability to highlight consensus or conflict among ethical frameworks serves as a powerful educational and deliberative tool for transplant teams. Nevertheless, successful implementation requires ongoing validation for algorithmic bias, configurable parameters to reflect local community values, and robust governance structures ensuring that the technology serves, rather than supplants, ethical reasoning. Future research should focus on real-time ethics monitoring, integration of patient-reported outcomes, and adaptation of the framework for global health contexts with different resource constraints.