บทความพิเศษ **Special Article**

Forensic Science in the Asia-Pacific: Artificial Intelligence trends and clinical applications

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Abstract

The Asian Forensic Sciences Network (AFSN) and the Asia Pacific Medico-Legal Agencies (APMLA) Annual Meeting 2025 took place in the Republic of Korea (September 15–19, 2025), celebrating the 70th anniversary of Korea's National Forensic Service (NFS). This report summarizes the key scientific and technological trends presented, alongside a personal reflection on the hospital's research contribution. **Materials and Methods:** This special article reviewed and analyzed data from a total of 332 technical abstracts (160 oral and 172 e-poster presentations) delivered across various Working Groups. A quantitative assessment of the application of Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) technologies was performed. **Results:** A total of 39 presentations were identified as related to AI/ML/DL, predominantly focusing on Digital Forensics and Forensic Medicine. The author's research, "Using Machine Learning Models to Identify Key Clinical Clues in Forensic Detection of Nasal Bone Fractures" (FMWG-PP-15), was the sole abstract from the Ministry of Public Health (MOPH) and the only e-poster applying ML to clinical forensic diagnosis. The Random Forest model achieved high predictive ability (AUC 0.95) by identifying nasal ridge crepitation/stepping as the key clinical predictor. **Conclusion:** A prevailing trend in the Asia-Pacific region is the significant transition toward AI-driven forensics, presenting a crucial opportunity to incorporate machine learning technologies into hospital-based clinical forensic diagnostics. This integration aims to improve the accuracy and standardization of injury assessments and advance the development of forensic sciences.

Key words: Artificial intelligence, Machine learning, AFSN.

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บทคัดย่อ

การประชุมเครือข่ายนิติวิทยาศาสตร์แห่งเอเชีย (AFSN) และองค์กรแพทย์นิติเวชแห่งเอเชียแปซิฟิก (APMLA) ประจำปี 2568 จัดขึ้นที่สาธารณรัฐเกาหลี (15–19 กันยายน 2568) เพื่อเฉลิมฉลองครบรอบ 70 ปี สถาบันนิติวิทยาศาสตร์แห่งชาติเกาหลี (NFS) รายงานนี้สรุปการนำเสนอแนวโน้มทางเทคโนโลยีและวิทยาศาสตร์ที่สำคัญ พร้อมทั้งสะท้อนประสบการณ์ส่วนตัวในการนำเสนอผลงานวิชาการของโรงพยาบาล **วัสดุและวิธีการศึกษา:** บทความพิเศษนี้วิเคราะห์ข้อมูลจากบทคัดย่อทั้งหมด 332 เรื่อง (นำเสนอด้วยวาจา 160 เรื่อง และนำเสนอด้วย e-poster 172 เรื่อง) ที่นำเสนอในการประชุม โดยเน้นการวิเคราะห์เชิงปริมาณและเชิงคุณภาพต่อการประยุกต์ใช้เทคโนโลยีปัญญาประดิษฐ์ (AI) การเรียนรู้ของเครื่อง (ML) และการเรียนรู้เชิงลึก (DL) **ผลการศึกษา:** พบว่ามีการนำเสนอที่เกี่ยวข้องกับ AI/ML/DL รวมทั้งสิ้น 39 รายการ งานวิจัยของผู้นิพนธ์ “การใช้โมเดลการเรียนรู้ของเครื่องเพื่อระบุลักษณะทางคลินิกสำคัญในการตรวจพบกระดูกจมูกหักในงานนิติเวช” (FMWG-PP-15) เป็นบทคัดย่อเดียวจากกระทรวงสาธารณสุขที่นำเสนอในที่ประชุม ซึ่งใช้โมเดล Random Forest ระบุร่องรอยการแตก/ยุบของสันจมูกเป็นตัวแปรทำนายที่สำคัญที่สุด (AUC 0.95) เพื่อปรับปรุงการวินิจฉัยทางคลินิก **สรุป:** แนวโน้มในเอเชียแปซิฟิกชี้ให้เห็นการเปลี่ยนแปลงสู่ AI-Driven Forensics ซึ่งเป็นโอกาสสำคัญในการบูรณาการเทคโนโลยี ML เข้ากับการวินิจฉัยทางนิติเวชทางคลินิกของโรงพยาบาล เพื่อเพิ่มความแม่นยำและมาตรฐานในการตรวจสอบบาดเจ็บ และความก้าวหน้าทางนิติวิทยาศาสตร์

คำสำคัญ: ปัญญาประดิษฐ์, การเรียนรู้ของเครื่อง, การประชุมเครือข่ายนิติวิทยาศาสตร์แห่งเอเชีย

Introduction

The Asian Forensic Sciences Network (AFSN)[1] and Asia Pacific Medico-Legal Agencies (APMLA)[2] Annual Meeting 2025, held in the Republic of Korea from September 15 to 19, 2025, brought together regional and international experts under the main theme: "Together for Tomorrow: Leading Asia’s Forensic Future - Advancing Asia’s Role in Forensic Science through Innovation and Global Collaboration". The conference, which coincided with the 70th anniversary of Korea’s National Forensic Service (NFS), featured a comprehensive program with 332 total technical abstracts, divided equally between 160 oral presentations and 172 e-poster presentations.

This report aims to summarize the most significant scientific and technological advances presented at the conference, with a particular emphasis on the increasing role of Artificial Intelligence (AI) and Machine Learning (ML). Furthermore, it provides a personal reflection on the experience of presenting our research and identifies key areas where Ministry of Public Health (MOPH) institutions, particularly in clinical forensic medicine, can strategically align their future research and collaborative efforts with leading regional partners.

Materials and Methods

This conference report, structured as a Special Article, is based on the comprehensive review and analysis of the official conference abstract book and programmatic details[3], as well as my personal

experience attending several conference sessions. The scope was restricted to identifying overarching technological trends, advancements in specific forensic working groups (WG), and synthesizing the relevance of these developments to clinical forensic practice in the hospital setting. A specific focus involved the quantitative assessment of presentations incorporating advanced computational techniques, including AI, ML, Deep Learning (DL), Large Language Models (LLMs), and Digital Twin technologies, drawing directly on thematic classification performed in conversation history.

Results

AFSN & APMLA KOREA 2025 gathered distinguished experts to address current challenges, explore future directions, and share knowledge within a comprehensive program featuring 332 technical abstracts, including 160 oral and 172 e-poster presentations. The insights gained from these topics left a strong impression and significantly enhanced my knowledge.

I. Overview of abstracts submitted to the conference.

Table 1 Abstracts classified by Working Group (WG)

Working Group*	Oral presentation (OP)	E-Poster presentation (PP)	Total
DNAWG	25 (OP-01 to OP-25)	53 (OP-01 to OP-54, withdraw 1)	78
TXWG	11 (OP-01 to OP-11)	30 (PP-01 to PP-30)	41
FMWG	13 (OP-01 to OP-13)	20 (PP-01 to PP-20)	33
CSIWG	21 (OP-01 to OP-21)	11 (PP-01 to PP-11)	32
TARWG	16 (OP-01 to OP-16)	5 (PP-01 to PP-05)	21
TEWG	8 (OP-01 to OP-08)	13 (PP-01 to PP-13)	21
DFWG	18 (OP-01 to OP-18)	0	18
IDWG	14 (OP-01 to OP-14)	8 (PP-01 to PP-08)	22
FPWG	8 (OP-01 to OP-08)	5 (PP-01 to PP-05)	13
QDWG	10 (OP-01 to OP-10)	3 (PP-01 to PP-03)	13
APMLA	10 (OP-01 to OP-10)	7 (PP-01 to PP-07)	17
KSFS	0	16	16
QASC	6 (OP-01 to OP-06)	1 (PP-01)	7
Total	**160**	**172**	**332**

* **DNAWG**: DNA Working Group, **TXWG**: Toxicology Working Group, **FMWG**: Forensic Medicine Working Group, **CSIWG**: Crime Scene Investigation Working Group, **TARWG**: Traffic Accident Reconstruction Working Group, **TEWG**: Trace Evidence Working Group, **DFWG**: Digital Forensics Working Group, **IDWG**: Illicit Drugs Working Group, **FPWG**: Fingerprint Working Group, **QDWG**: Questioned Document Working Group, **APMLA**: APMLA Program, **KSFS**: Korean Society of Forensic Science, **QASC**: Quality Assurance & Standards Committee.

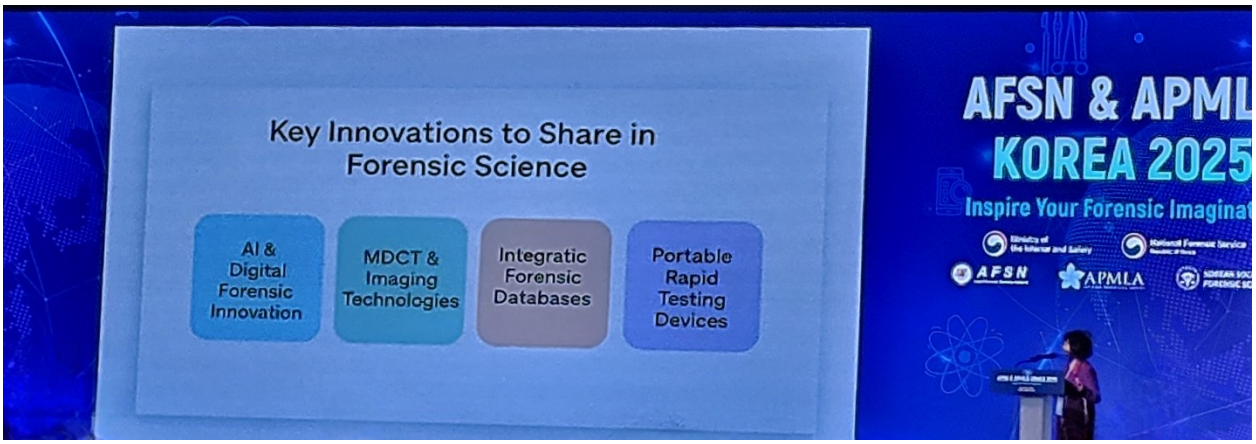

Figure 1 Presentation slide at the AFSN & APMLA KOREA 2025 conference by Prof. Hee Sun Chung, Department of Forensic Science, Sungkyunkwan University, Republic of Korea, highlighting key innovations to share in forensic science, including AI & digital forensic innovation, MDCT & imaging technologies, integrative forensic databases, and portable rapid testing devices.

II. Abstracts related to Artificial Intelligence and Machine Learning in Forensic Innovation.

A total of 39 abstracts across the program (OP, PP, and selected Talks) were identified as explicitly involving AI, Machine Learning, Deep Learning, or related concepts (such as LLMs, Neural Networks, or Generative AI).

Table 2 Abstracts related to Artificial Intelligence and Machine Learning by country of affiliation

Country / Agency	Number of Abstracts	Examples of Application (Source)
Republic of Korea	14	Deepfake Detection, Bloodstain Deep Learning (VDSR), AI in Traffic Accident Simulation (YOLO, ML for Airbag Deployment), AI-Enhanced Drug Detection Strips, Geolocation Prediction (XGBoost), PMCT/AI Models.
China (including Hong Kong SAR)	11	AI Agents/LLMs for Evidence Chain, Sharp-Injury Classification (XAI/DL), AI in CSI Reconstruction, Stable Diffusion Image Evaluation, Deep Learning for NPS Identification (CNN), AI for Fingerprint Future, Automated Font Recognition, Robotic Handwriting, Smart Lab QA (Digital Twin), PT for AI-Generated Images.
Singapore	3	GenAI for Quality Management (ChatQM), Automated Ignitable Liquid Classification.
India	2	Deep Learning for Latent Fingerprint Reconstruction, AI in Diatom Taxonomy for Drowning Cases.
Indonesia	2	Facial Age Estimation (AI), Dental Radiograph Biometric Signatures (AI).

Malaysia	2	AI for CSAM Detection, Biometric Forensics via AI/Big Data.
Thailand	1	Machine Learning for Nasal Bone Fracture Detection
Japan	1	Future of Autopsy Imaging ("Ai × AI").
Australia	1	AI in Forensic Document Examination (Talk).
Switzerland	1	Deterministic Probabilistic Genotyping (Simulation-based ML).
Bulgaria	1	AI-Powered Analysis in Forensic Imaging (Talk).

The distribution of these AI/ML-related presentations highlights significant investment in computational forensics by specific member nations. Examples of AI and machine learning applications in forensic science presented at the conference are as follows:

1. Digital Forensics (DFWG): This group drove much of the AI research. Key advancements included Deep Learning algorithms for Deepfake detection and methods to evaluate images generated by AI models like Stable Diffusion using deep learning features. Research also explored integrating Large Language Models (LLMs) and AI Agents to manage the entire forensic evidence lifecycle, from intelligence gathering to courtroom presentation, aiming for qualitative and efficiency leaps in forensic operations.

2. Quality Assurance (QASC): AI is being used proactively to enhance laboratory integrity. Presentations detailed the concept of "Smart Labs" using AI and Digital Twin technologies for research on quality assurance. Furthermore, Generative AI (GenAI) was presented as a solution for quality management via tools like ChatQM, a virtual assistant designed to simplify complex quality standards queries.

3. Pattern and Trace Evidence (CSIWG & TEWG): AI provided enhanced objectivity and automation. This included deep learning methods for bloodstain image enhancement and developing machine learning models (such as Convolutional Neural Networks) for the objective classification of Ignitable Liquid Profiles in fire debris based on standardized criteria.

4. Advances in Forensic Medicine (FMWG) and the Role of Imaging:

The Forensic Medicine Working Group demonstrated a strong move toward integrating imaging and AI in trauma and death investigation. The following topics are among those I attended during the conference.

- **Automated Injury Classification:** Researchers presented an Explainable Deep Learning (XAI) framework for automated classification of sharp-force injuries (stab, chop, slash wounds) in homicide forensics. One model (GoogLeNet) achieved an overall accuracy of 88.2%, with a concordance rate of 91.5% in field-testing against expert expectations. However, after the presentation, I also took the opportunity to ask the speaker questions in the room, which provided further valuable insights into the application of this technology. I have suggested considering the use of object detection models like YOLO (You Only Look Once) for identifying

multiple wound types within a single image, as this approach more closely reflects real-life forensic practice.

- **Postmortem Imaging (PMCT):** Keynote and workshop sessions emphasized the crucial role of Postmortem Computed Tomography (PMCT) as an essential pre-autopsy tool. PMCT data is now routinely used for craniofacial identification (reconstruction, superimposition) and detailed analysis of trauma mechanisms in firearm or sharp-weapon-related deaths. The goal is to maximize knowledge transfer from the deceased ("Mortui Vivos Docent") through scientific inquiry integrated with advanced imaging.
- **The Contribution of Hospital-Based Clinical Forensics:** The e-poster presentation, "Using Machine Learning Models to Identify Key Clinical Clues in Forensic Detection of Nasal Bone Fractures" (FMWG-PP-15), was presented by the author. This research represented the sole institutional contribution from the Ministry of Public Health (MOPH) at the conference and was one of the very few abstracts specifically applying AI/ML/DL to improve clinical forensic diagnostics. The study evaluated the utility of a Random Forest classifier in predicting nasal bone fractures using routine clinical signs. The model achieved a high predictive ability (Area Under the Curve, AUC 0.95), finding that the presence of nasal ridge crepitation or stepping was the most critical clinical clue, with a feature importance of 42.8%. This finding provides an objective, ML-guided standard to assist frontline forensic physicians in determining which patients require immediate radiological referral, addressing resource optimization and potential missed diagnoses in medico-legal trauma cases.

Discussion

Currently, crimes and toxicological substances frequently cross borders, making awareness of other countries crucial for early warning and recognition. People can easily cross borders, and illnesses or deaths from causes uncommon in Thailand but affecting foreigners should always be considered during autopsy examinations. Furthermore, areas of forensic interest or specialization may not yet be well developed in Thailand. The AFSN & APMLA KOREA 2025 conference confirmed that the forensic science community in the Asia-Pacific region is undergoing a profound paradigm shift toward technological centralization and objective standardization. This transformation is guided by comprehensive quality frameworks, notably ISO/TC 272, which seeks to establish standards encompassing the entire forensic process and extends beyond the traditional scope covered by ISO/IEC 17025. Additionally, ongoing regional capacity-building support through Official Development Assistance (ODA) projects by institutions such as Korea’s National Forensic Service (NFS) highlights a robust collaborative spirit in the region.

Leveraging hospital expertise through AI

The experience of presenting the nasal fracture research highlights a crucial opportunity for hospital-based forensic departments. While national laboratories often lead complex molecular and digital forensics, hospitals manage the primary intake of trauma and clinical cases. Our research demonstrates that low-cost, effective tools, such as Machine Learning models, can be developed using existing clinical data to transform subjective clinical judgment into objective, evidence-based assessments. Our work was unique in applying ML to a core clinical forensic diagnostic problem in an e-poster session, confirming the high relevance of this domain.

Future collaborative trajectories

To maximize the benefits of this conference experience, future work should focus on three collaborative trajectories, moving from "reactive documentation" to "proactive prediction and standardization":

1. AI in clinical trauma assessment: We should seek scientific collaboration with regional partners (e.g., China's Ministry of Public Security or Korean universities) to expand the current ML framework to classify and predict other complex soft tissue and skeletal trauma patterns, similar to the XAI sharp-injury classification presented. This will lead to standardized, objective clinical reporting.

2. Forensic imaging integration ("Ai × AI"): Recognizing the importance of PMCT, collaboration should be established to share data and standardize protocols for postmortem imaging, especially for complex identification (craniofacial) and trauma mechanism analysis. The development of AI models based on CT data, as pioneered by the NFS, is a crucial long-term goal for enhancing hospital autopsy services.

3. Adoption of Next-Generation molecular screening: While AI dominates the digital sphere, molecular diagnostics are leaning towards isothermal detection. The Direct-LAMP-Based Molecular Diagnostic Kit for on-site screening of male DNA, saliva, and ABO genotype presented by Sungkyunkwan University offers a cost-effective, rapid, and field-deployable technology that could significantly enhance evidence collection efficiency in our local settings, justifying the strategic exploration of collaboration on its validation and use.

Benefits to Maharat Nakhon Ratchasima Hospital from Joining the Networks

In the near future, by becoming members of APLMA and AFSN, we can expect to gain the following benefits:

1. Membership in APLMA and AFSN enables the Forensic Department at Maharat Nakhon Ratchasima Hospital to exchange knowledge, participate in training, and collaborate on research with international institutions. This elevates forensic and medico-legal services to meet global standards, enhancing credibility and service quality.

2. Being part of the network creates opportunities for cooperation in cases of missing persons, disasters, and major incidents, allowing the hospital staff to gain experience and access new technologies from international experts. This fosters professional growth and career development.

3. The hospital can utilize data and guidelines from the network to enhance investigative procedures, support justice and public health systems, promote community well-being, and elevate operational standards. Membership also boosts the hospital's reputation within the community and external organizations, while affirming the quality and reliability of its forensic services, in alignment with the Ministry of Public Health's goals for forensic service excellence[4]

Conclusion

The AFSN & APMLA KOREA 2025 meeting showcased a regional commitment to forensic innovation, characterized by the aggressive adoption of AI/ML technologies and a renewed focus on holistic quality standardization. The successful presentation of the MOPH's clinical ML research at this international forum demonstrates that hospital-based forensic medicine plays a viable, unique, and necessary role in advancing objective forensic practices. Moving forward, strategic scientific collaboration focusing on AI-assisted clinical assessment and advanced molecular imaging will be essential to elevate the standards and efficiency of our forensic services, directly supporting the mission of public health and justice in the region.

References

1. Asian Forensic Sciences Network [Internet]. [cited 2025 Sep 24]. Available from: https://afsn.asia
2. Asia Pacific Medico-Legal Agencies [Internet]. [cited 2025 Sep 24]. Available from: https://theapmla.net
3. AFSN & APMLA KOREA 2025. AFSN APMLA KOREA 2025_Abstract Book. In 2025 [cited 2025 Sep 23]. p. 1–333. Available from: https://asianforensic2025.com/assets/file/AFSN%20APMLA%20KOREA%202025_Abstract%20Book_FINAL2.pdf
4. กองบริหารการสาธารณสุข. แนวทางพัฒนาระบบนิติเวช สำนักงานปลัดกระทรวงสาธารณสุข. ยุภา คงกลิ่น สุคนธ์, จุฑามาศ มหานันทโพธิ์, กานต์ชนก บัวสรวง, editors. กรุงเทพมหานคร: กองบริหารการสาธารณสุข สำนักงานปลัดกระทรวงสาธารณสุข; 2566. 1–40 p.