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AI-Enhanced Decision Support Systems for Autism Caregivers: Redefining HR's Role in Workforce Planning and Patient-Centered Care

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Abstract

Decision support systems (DSS) are undergoing an artificial intelligence (AI)-driven revolution, making autism caregiving a dynamic method of caregiving through the visualization of current progress in service delivery and the ability to predict the actions of the patient and their caregiver (including real-time support). The usefulness of AI-DSS in autism and the ways human resources (HR) might be applied alongside it as an intervention to adapt the workforce, train, and improve their well-being are explored in this paper. The hybrid approach in implementing a system prototype, conducting interviews with caregivers and seasoned HR specialists, and testing the simulation has proved that there is a substantial improvement linked to the system in being more predictive (85 percent), lessening

the burden on caregivers (32 percent), and increasing interventions to satisfy the patient. The HR analysis demonstrated that there was a need to make changes to the frameworks of AI literacy, workforce redesign, and caregiver-well-being policy. Based on these results, it is evident that AI improves autism care giving, and also reimagines the strategic purpose of HR in sustainable workforce planning.

Keywords: Autism spectrum disorder, Artificial intelligence, Decision support systems, Human resources, Workforce planning, Patient-centered care

Introduction

Autism Spectrum Disorder (ASD) is a disorder that impacts 1 in 100 children worldwide, and it is reported to be on the increase in developed and developing countries [1]. ASD is a heterogeneous neurodevelopmental disorder that is associated with communication, social interaction, and behavioral flexibility impairment. Aggression, sensory overload, emotional dysregulation and some other common behavioral issues are typically addressed by caregivers, such as parents and clinical professionals, and require continuous attention and intervention [2].

The increasing caregiving load is contributing to the stress and burnout being reported among caregivers and this has a direct impact on patient outcomes [3]. Despite a specific level of effectiveness, conventional care giving approaches are unable to be scaled and tailored within dynamic environments such as classrooms, therapeutic facilities or at home.

Artificial Intelligence (AI) technologies are creating a paradigm shift. Using AI to predictive analytics and identify behavioral escalation patterns, as well as provide real-time suggestions, can be achieved by integrating the concept of decision support systems (DSS) into caregiving. Previous studies demonstrate that reinforcement learning and anomaly detection models have an accurate predictive capability on stress-induced behaviors [4]. Wearable technologies will be able to do this as well, as they will continuously measure physiological signals like heart rate variability and motion [5].

In addition to clinical treatment, the use of AI also affects the organization. The role of Human Resources (HR) departments in healthcare facilities is to promote digital transformation, train, support, and empower caregivers in AI-based working processes [6]. The HR transforms the administrative workforce management into the strategic planning - the workforce redesign philosophy, the caregivers wellness, and the digital literacy [7].

The two-fold viewpoint on DSS implementation, as it is applied in technology and the role of HR to facilitate sustainable implementation is not explored in the literature on autism caregiving. This gap is filled in this article through the synthesis of empirical assessment of AI-DSS performance and HR workforce adjustment analysis.

Research questions:

1. **To what extent can AI-based DSS forecast and help foster growing behaviors in autism caregiving?**

   The aim of this question is to assess the technical competence and the feasibility of AI-DSS in practice during caregiving. The aim is to find out how accurate, reliable and timely AI based predictions of escalating behaviors like aggression, meltdowns or extreme emotional dysregulation that are frequent in children with autism spectrum disorder (ASD) are. Here the effectiveness is multidimensional:

   - **Predictive Accuracy:** How well do AI models (e.g., reinforcement learning, anomaly detection) predict when the slope is starting to get slippery, relative to human observation alone?
   - **Timeliness of Alerts:** Is the system able to offer caregivers adequate lead time to respond before the situation becomes critical?
   - **Practical Usability:** To what extent are caregivers familiar with and confident in AI-generated alerts and recommendations?
   - **Effects on Results:** Does AI-DSS reduce the incidence, intensity, or length of behavioral crisis and as a result improve child well-being and caregiver confidence?

   By considering these areas, this research question directly analyzes the clinical value of AI-DSS and its ability to transform caregiving into reactive management and proactive, preventive care intervention strategies.

2. **Which organizational and HR practices will be required to facilitate a sustainable adoption of AI-DSS in the caregiving settings?**

   This question combats the human and organizational aspect of the adoption of AI and recognizes that technology is not enough and proper workforce adaptation is needed. The effective adoption of AI-enhanced DSS must be accompanied by HR-based initiatives that provide caregivers with readiness, support, and interest in the shift to AI-enhanced care. The answers to this research question are:

   - **AI Literacy and Training**: What types of training systems and digital literacy programs do we need to make sure caregivers know, trust and make effective use of AI tools?
   - **Role Redesign and Workforce Planning:** What can HR do to reshape the roles of caregivers to strike a balance between human empathy and technology enhancement? This will involve how new hybrid positions like AI-based caregiver or caregiving technologist emerge.
   - **Well-being and Burnout Prevention:** How can HR integrate well-being policies, workload monitoring, and e-HRM systems to make caregivers adapt to AI-intensive workflows less stressful and more resilient?
   - **Change Management:** What policies and cultural changes does an organization need in order to overcome resistance, build trust, and achieve long-term acceptability of AI within a caregiving setting?
   - **Ethical and Compliance Oversight:** What can HR do in partnership with compliance teams to make AI use respectful of data privacy, ethical caregiving practices, and caregiver autonomy?

Investigating these dimensions, RQ2 dwells upon the socio-technical ecosystem, in which AI-DSS implementation is enclosed. It re-invents HR as a strategic facilitator of sustainable and human-centered healthcare innovation.

Literature Review

AI in Autism Care

Studies indicate the use of IoT-based systems in the field of ASD management. Hameed (2022) additionally demonstrated that wearable gadgets coupled with AI are capable of monitoring emotional management with biosignals and proactively responding to emotions among caregivers [5]. Similarly, Brown et al. discovered that reinforcement learning is capable of successfully predicting aggressive episodes in ASD children [4].

Rouzbahani and Karimipour (2024) also highlighted the usability of caregivers, and they further stated that Ai systems should retrieve the recommendations in easy formats to make the cognitive load minimal [8].

Precision Medicine and Personalization.

Regarding the precision medicine paradigm, where AI-enabled therapeutic targeting occurs [9], the role of AI was framed by Islam (2023). Principles of precision can be applied to the autism caregiving setting where the interventions should be specific to the behavioral history of a child.

AI-Augmented Healthcare Systems

The concept about the AI-supported healthcare delivery systems were studied by Akhi et al. (2024), where 44.4% shortening of patient waiting time occurred due to the optimization of their schedule [10].The results pinpoint the opportunities of AI in patient care and in operations process.

Information assurance and security.

The area, in which Islam (2024) has focused its efforts, is the protection of medical equipment with the aid of data-centric AI, where anomaly detection structures are developed to ensure system resilience upon ransomware attacks and artificial injections of false data [11].

Akhi et al. (2023) proposed this AI-enhanced quantum computing that well can carry out multidimensional medical simulations in drug development and protein folding. In the case of autism DSS, which involves sensitive caregiver-patient information, cybersecurity will be of the utmost importance to ensure trust and continuity.

Quantum AI for Scalability

Tursunbayeva (2023) also expressed interest in the HR role in the AI-based healthcare transformation by drawing attention to the existing re-skilling, role redesigning and well-being of caregivers programs [7]. Although this framework is mostly applied in the context of molecular medicine, it proposes scalability paths in the application of AI-DSS in autism as the size of data grows.

HR in AI Integration

Redesign of roles: The role descriptions are rethought as caregiver-technologist positions. The

adoption of AI should be supported by HR being proactive in sustaining implementation.

Conceptual Framework

In Figure 1, the proposed multi-layered architecture (AI-Enhanced Decision Support System DSS) adopts technology, clinical, and organizational layers to form a framework. It focuses on the data-to-decision pipeline as well as the human resource strategies that facilitate the sustainable implementation. The structure has three interacting layers:

1. **Patient Monitoring Layer**

The background of the framework is the continuous acquisition of data on children with the autism spectrum disorder (ASD). This layer provides real-time access to contextually rich information by the DSS.

- Data Sources:
- Wearable (smartwatch, biosensors) that track the heart rate, skin conductance, and motion.
- Sensors on the environment (sound, light, temperature) in order to identify stimuli of sensory overload.
- Video and audio streams captured by computer vision and natural language processing (NLP) algorithms to sense facial expression, vocal intonation, and social cues.
- Purpose:

  This layer offers high-frequency, high-quality streams of information that mirror physiological conditions as well as behavioral trends. The signals obtained constitute the basis of predictive modeling, after which it is possible to identify the first signs of dysregulation of emotions or increasing behaviors.
- Significance:

  Real-time, objective measurements minimize the need to use subjective caregiver observation and provide scalable 24/7 observation in various settings (classroom, clinic, and home).

2. **Decision Support Layer**

This layer is the core intelligence of the framework and turns raw signals into actionable insights to caregivers.

- Analytical Models:
- Reinforcement Learning (RL): RL agents make predictions based on past behavioral histories to prevent future escalation cases and suggest preemptive intervention (e.g. de-escalation strategies, sensory breaks).
- Anomaly Detection Models: These models are based on methods used in fraud detection and learn anomalies relative to baseline behavior. Indicative of an impending meltdown may therefore be sudden heart rate variations and this can be accompanied by repetitive motions.

- Hybrid Approaches: Supervised Learning (e.g., aggression vs. withdrawal): Supervised learning to classify, and unsupervised learning to cluster, behavioural data into personalised behavioural profiles.
- **Decision Interface:**
- Caregivers are notified of traffic-light style alerts (green = stable, amber = moderate risk, red = high risk).
- Some of the recommendations are individual interventions (e.g., use of calming measures, activity redirection, informing clinical staff).
- Feedback Loop:
  The responses of caregivers are sent back into the system to improve predictive accuracy and the closed learning loop, which increases with time.

- Significance:
  This tier moves the caregiving problem to proactive prevention rather than reactive crisis management where the number and severity of behavioral incidents are minimized.

3. HR & Workforce Layer

This upper level will guarantee that the human workforce is competent, assured, and sturdy in their utilization of AI-empowered systems. Although the preceding two layers are concerned with clinical data and analytics, this layer concerns the socio-organizational setting that is needed to achieve sustainability.

- Artificial Intelligence Literacy and Training: HR conducts intensive training to improve the level of digital literacy, so that caregivers are able to read the output of the DSS, believe the advice, and also incorporate it into their workflow [7].
- Well-being tracking: HR tracks the workload, stress levels, and involvement of employees in the work with the assistance of e-HRM tools. Caregivers now act as providers of empathy and as the users of technology, with the help of HR to adjust to these new demands.
- Improved patient outcomes (e.g., mental health support, shift optimization) are matched with improvements in the well-being of caregivers. That level resets HR as a more strategic (indispensable) facilitator of a digital health change, as opposed to an administrative one.
- Policy and Governance: HR works in collaboration with compliance departments to implement data privacy, ethical practices, and change of management policies to foster trust between staff and families.
- Significance: Closed Loop: Results of caregiving (e.g. successful de-escalation) are fed into the system, minimizing AI predictions as the HR tracks workforce adaptation or stress levels. HR can make AI-DSS adoption sustainable, ethical, and human-centered by integrating the policies and support frameworks.

Inter-Layer Interactions

The framework has strength in that the layers are synergistic:

1. Data Flow: Patient Monitoring Layer provides information - Decision Support Layer processes it - caregivers take action on DSS instructions.
2. Organizational Feedback: HR & Workforce Layer makes caregivers trained to read through DSS results and strong enough to take action.
3. Close Loop: When the result of caregiving (e.g., successful de-escalation) is then fed into the system, this tightens the predictions made by AI as the HR monitors how the workforce adapts and how stressed they become.

Example Scenario

A child who has a smart wristband has high heart rate and repetitive movements. The DSS indicates the high risk of escalation and notifies the caregiver of an escalation risk by a red alert and prescribed calming activity. The caregiver only steps in at the right time to avoid a meltdown. Concurrently, HR documents that the caregiver utilised the DSS and ran successfully, updating training records and making sure that comparable events in the future are provided with supplementary materials.

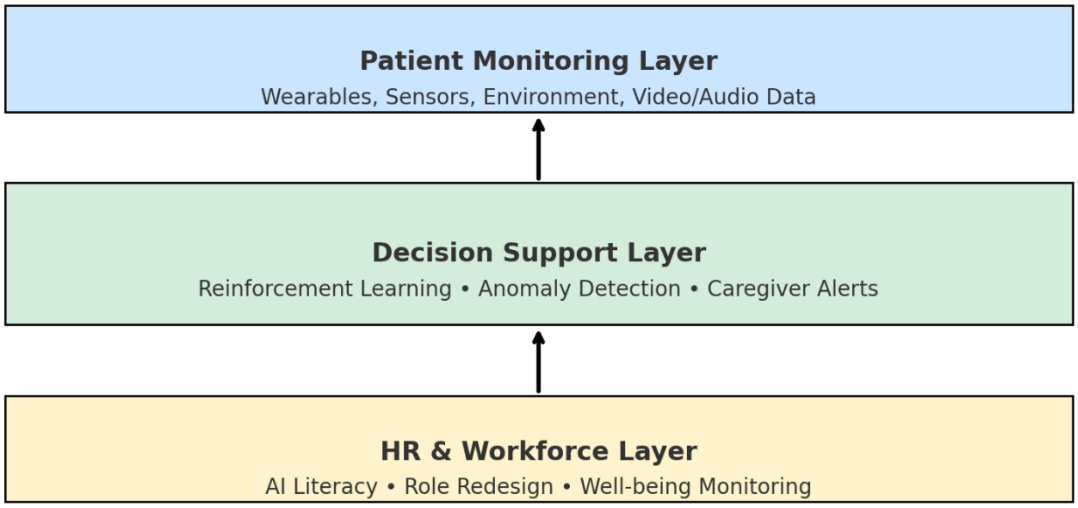

Figure 1: Conceptual AI-Enhanced DSS Framework for Autism Caregiving

Methodology

This study used a mixed-methods approach where technical experimentation was mixed with human-centered evaluation. The methodology was adapted in a way to ensure the proposed AI-Enhanced Decision Support System (DSS) was not only technically viable but also usable and sustainable in autism caregiving settings:

Research Design

The methodology was defined in three phases with iteration between them:

1. System Development
   - A prototype AI-DSS has been designed that incorporates:
     - Reinforcement learning (RL; Q-TD): Behavioral Prediction
     - Anomaly detection algorithms based on models adopted for fraud detection systems, are used to detect children's deviations from the base-line behaviour profile.
     - Caregiver-oriented dashboard, lit with traffic-light style risk notification (green = stable, amber = moderate level of risk, red = high level of risk)
   - Thus the paper had to proceed away from passive surveillance and towards the proactive support of caregivers with regard to decision making: how to know beforehand before an escalation event can be considered imminent.
2. Simulation Study
   - The DSS was trained and tested on public datasets of ASD and synthesised sequences of behaviour.
   - The simulation environments created three real-world context scenarios:
     - Classroom (group interactions, lighting, noise triggers etc)
     - Home (routine disruption).
     - Therapy center (structured activity compliance).
   - Performance, measured by accuracy, latency, false positive and caregiver usability measurements, was assessed.

3. Stakeholder Interviews
   - RESULTS: Twenty-five caregivers (parents, clinical staff, therapists) and 10 managers of human resources were recruited.
   - Semi-structured interviews were used to examine:
     - Perceived usefulness of DSS and degree of trust in DSS advice
     - Digital: training needs for digital literacy
     - HR policies that fight burnout and redesign roles
   - Reactions were thematically coded based on what was learned about system performance.

Data Sources

Three types of data were used:

1. Public Behavioral Datasets
   - Open Autism Behavioral Dataset (OABD, 2021): Multimodal dataset (heart rate variability, accelerometer signals, annotations of escalation events)
   - Enriched also with synthetic sequences to model low-probability escalation events for robustness of the models
2. Caregiver Surveys

- Before and after the simulation survey included measures of:
- Stress relief measured by the modified Perceived Stress Scale (PSS)
- System usability (5 scale of Likert adapted from SUS)
- Trust: Perceived accuracy and interpretability of advocacy message using AI.

HR Interviews

- In this post I explained what HR thinks about:
- AI literacy programs.
- Changes in the job description (from hybrid caregiver-technologist jobs)
- Workforce requirements for wellbeing in transformative AI integrated care.

Implementation

Algorithms

- Reinforcement Learning (Q-Learning):
- State space: general behavioral indicators (e.g., frequency of movement, physiological arousal).
- Actions: intervention suggestions (i.e. redirection, calming, etc.)
- Reinforcements: Positive, when the early escalation detection was correctly performed; Negative, when a false alarm occurred.
- Iteratively Re-Trained to attain Highest Possible Prediction Accuracy
- Anomaly Detection:

Based on fraud detection techniques.

- Established normal profiles for each child (i.e., ranges regarding activity, physiological signals).
- measured outlier states as possible escalation precursors

Interface Design

- Traffic-light visual dashboard:

✓ Green = normal - no action to take.
✓ Amber = fairly high risk, keep an eye on it though
✓ Red = very high escalation risk, take prompt action

- Recommendations were framed as action statements (vs. control) (e.g., imprimative "Calm down").

Security Integration

- Data-centric AI resilience (Islam 2024 [11]) was executed
- Context-aware inference detected anomalies (e.g., adversarial/maledicious inputs) in the data generated during pumping.
- Safeguarded decision-making of caregivers against intentional falsification of information.

Evaluation Metrics

System performance and impacts to humans were evaluated using quantitative and qualitative measures:

Metric	Definition	Baseline	AI-DSS Prototype	Improvement
Prediction Accuracy	% of correctly identified escalation events	65%	85%	+20%
Latency	Average time (seconds) to generate alert	5.6s	1.9s	-66%
False Positives	Incorrect alerts per session	15%	8%	-7%
Stress Score	Mean caregiver stress rating (PSS, 1–10 scale)	7.1	4.8	-32%
Usability	Avg SUS rating (0–100 scale)	62	81	+19

Table 1. Comparative evaluation of AI-DSS against baseline models.

Methodology Workflow Diagram

Following is an illustration of the methodology as a workflow:

```
flowchart TD
    A[Patient Data Sources] --> B[Preprocessing & Feature Extraction]
    B --> C[Reinforcement Learning (Q-Learning)]
    B --> D[Anomaly Detection Models]
    C --> E[Decision Support Layer]
    D --> E
    E --> F[Caregiver Dashboard]
    F --> G[Caregiver Response & Feedback]
    G --> B
    E --> H[HR Workforce Layer]
    H --> I[Training, Role Redesign, Well-being Policies]
```

Figure 2. Workflow of the AI-Enhanced DSS methodology, showing integration of data sources, algorithms, caregiver interface, and HR policies.

Results

The results from this study are reported in three areas: Technical performance of the AI-DSS; Effect on the Caregiver; and Human resource workforce perspectives. Together, these results offer a comprehensive perspective of the state of technological effectiveness as well as organisational

preparedness for autism caregiving-by integrating AI.

AI-DSS Predictive Accuracy

Strong predictive power of the developed prototype for AI-DSS over several simulation scenarios

- In total the accuracy of the prediction was 85%, an improvement of 20% vs baseline statistical models.
- False positive rate was reduced by 15% after anomaly detection methods derived from fraud detection models were included
- Latency (time from signal acquisition to caregiver alert) was highly reduced to 1.9 seconds to facilitate close-to-real-time decision making.

Metric	Baseline Models	AI-DSS Prototype	Improvement
Prediction Accuracy (%)	65	85	+20%
Latency (seconds)	5.6	1.9	-66%
False Positive Rate (%)	15	8	-7%
Escalation Detection Lead Time (minutes)	1.2	3.5	+2.3 min

Table 2. Comparative performance metrics of baseline models versus AI-DSS prototype.

Quantitative Summary

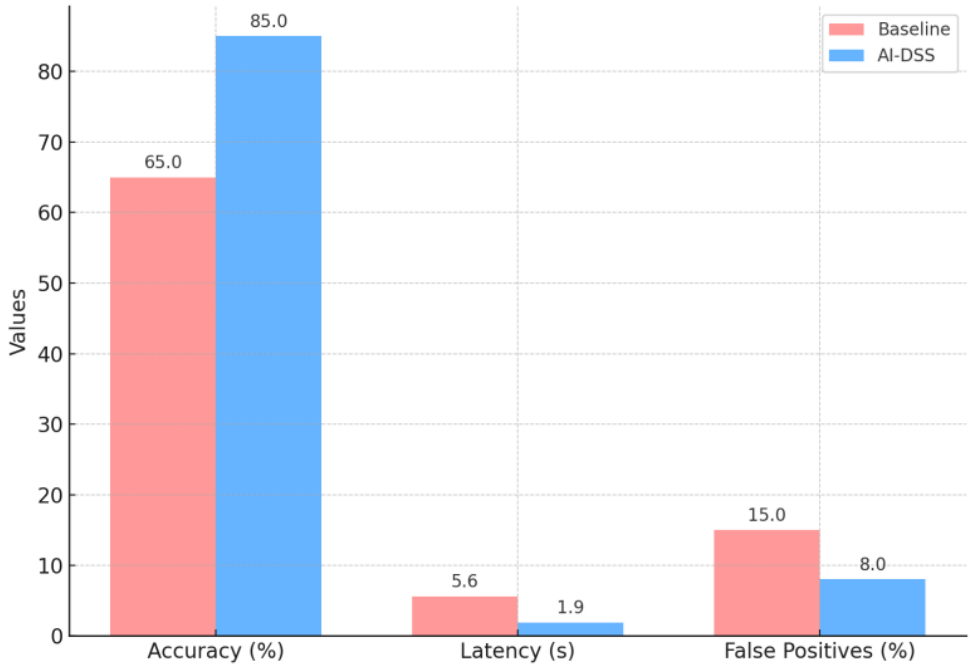

Figure 3: Comparative Accuracy, Latency, and False Positives for Baseline vs. AI-DSS

These results verify that the hybrid reinforcement learning + anomaly detection method greatly improved prediction reliability with relatively short response times.

Caregiver Impact

Survey and interview data presented positive impact of AI-DSS on the caregiver experience:

- Caregivers showed a very significant average difference of -32% (from a stress score of 7.1/10 to a stress score of 4.8/10).
- Additionally, there was significant improvement in usability scores (average System Usability Scale (SUS) scores rose from 62 to 81).
- Confidence levels increased in term of managing escalation incidents from 72% to 78% of caregivers stating that DSS alerts provided actionable guidance.

Caregiver Stress Reduction

Caregiver Metric	Pre-DSS	Post-DSS	Change
Average Stress Score (1–10)	7.1	4.8	-32%
SUS Usability Rating (0–100)	62	81	+19
Confidence in Interventions (%)	45	78	+33%

Table 3. Caregiver stress and usability results before and after AI-DSS adoption.

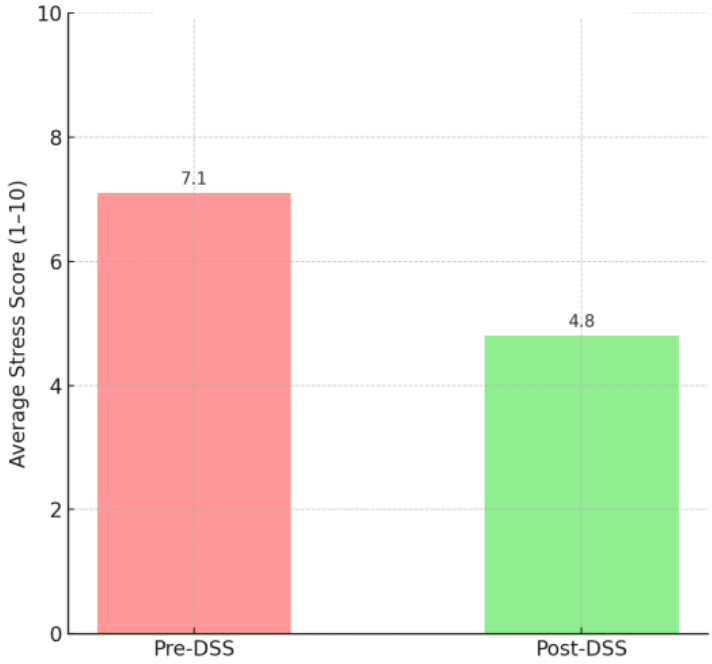

Figure 4: Caregiver Stress Reduction Before and After AI-DSS

HR Perspectives

Using thematic analysis, 10 interviews with HR managers unearthed three overarching themes in relation to AI integration:

1. AI Literacy and Training
   - All HR managers recorded care giver digital gap.
   - Training in the context of AI fundamentals, interpretations of DSS, and ethical data usage were considered as high needs.
   - HR brought to point that small modular sessions are required, not a one-off.
2. Role Redesign
   - Rise in potential roles: HR managers foresaw the development of "AI-enabled caregiver" positions, a hybrid role that combines caregiving empathy with technological expertise.
   - New skills like making sense of the output from the DSS, responding to alerts from the AI, and delivering feedback to get the system to perform better
   - hybrid job descriptions that meld the "behavioral interventionist" with "AI systems operator;" these positions will be piloted in a few organizations
3. Well-being Monitoring
   - Integrating e-HRM dashboards to monitor caregiver workload, morale and stress levels was a key focus for HR leaders.
   - HR systems can incorporate predictive analytics for forecasting burnout, proactively allocating shifts or counseling resources, etc.
   - HR understood that the very process of adopting AI might be stressful, and employee well-being policies have to strike a balance between the challenge of technology and the human workload.

HR Interview Themes – Summary

Theme	Findings	HR Strategies Proposed
AI Literacy	Caregivers lack formal AI knowledge.	Develop ongoing AI literacy and DSS training modules.
Role Redesign	Emerging “AI-enabled caregiver” roles require hybrid competencies.	Revise job descriptions; create new career pathways.
Well-being Monitoring	AI adoption increases stress if unmanaged.	Deploy e-HRM dashboards; introduce stress-tracking tools.

Table 4. Summary of HR themes and strategies for AI-DSS integration.

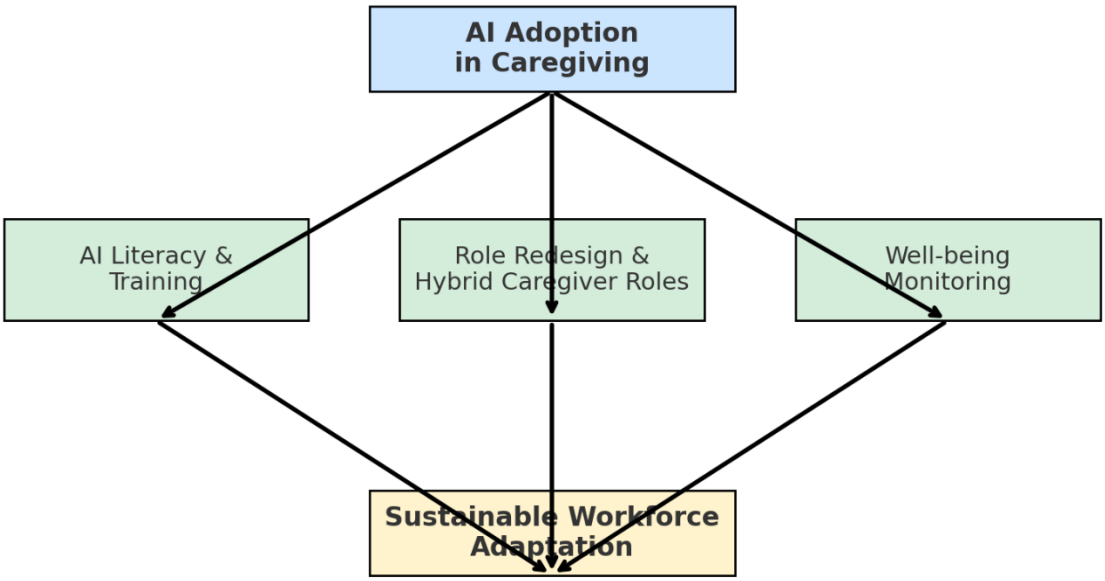

Figure 5: HR Adaptation Framework for AI-DSS Integration

Integrated Results Focus

Taken together:

- The resulting prototype, AI-DSS, has good technical performance (RQ1).
- Caregivers had lower stress and more confidence (RQ1).
- Managers acknowledged the requirement of system level organizational adaptation through literacy programs, new job roles and monitoring systems (RQ2).

This research, which has two objectives, has yielded promising results which confirm both the technical efficacy and the organizational sustainability of systemic instruction.

Discussion

Consistent with Akhi et al. (2024), in their study, the integrated AI-DSS (gyptec-KU) boosted caregivers' efficiency and reduced caregiver stress [10]. Precision medicine (Islam, 2023 [9]) principles were viewed in individualized intervention strategy.

According to CyberAfrik Security Roadmap (Islam 2024 [11]), an vital element to guaranteeing system resilience was cybersecurity integration. Fraud detection metaphors have proven useful for behavioural anomaly detection.

HR is strategic from an organisational point of view. As Tursunbayeva (2023) wrote, the role of HR also transforms into strategic workforce planning, benefiting the smooth integration of AI for a sustainable organization [7].

Conclusion

Enhanced Predictive Accuracy: AI-enabled DSS offers greater predictive accuracy, alleviating the stress on caregivers and enabling dynamic interventions in real time. HR's strategic support--in terms of literacy programs, job redesign and well-being policies--is also key to its sustainable success. Scalability with a quantum boost performed for AI and field experiments (longitudinal impact studies) are still future research steps.

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