Engineering and Scientific International Journal (ESIJ)
Volume 13, Issue 3, July – September 2026
ISSN 2394-7187(Online)
ISSN 2394 - 7179 (Print)

Early Palliative Care Integration in Advanced Gastric Cancer: A Twelve Month Comparative Cohort

Dr. Sudhir Kumar Tyagi[*1], Dr. Rashmi Sharma[*2], Ritu Verma[*3]

[1] *Professor, Department of Gen. Surgery, Saraswathi Institute of Medical Sciences, Hapur*
[2] *Professor, Department of Pharmacognosy, Saraswathi College of Pharmacy, Hapur*
[3] *Lecturer, Department of Child Health Nursing (CHN), Saraswathi College of Nursing, Hapur*

Abstract — Advanced gastric cancer carries one of the most demanding symptom burdens among solid tumours, with rapid deterioration in nutritional status, intractable pain, anorexia-cachexia, and disease-specific complications including obstruction and bleeding. Early integration of palliative care alongside disease-directed treatment has been shown in other tumour types to improve symptom control, quality of life, and end-of-life care quality. We compared 12-month outcomes between 122 patients with newly diagnosed stage IV gastric cancer enrolled in an early palliative care integration pathway and 120 receiving standard palliative care referral (typically later in the disease course). Mean ESAS total symptom score at 12 months was 24.2 in the early-integration arm and 36.4 in the standard arm. End-of-life care intensity differed substantially: ICU admission in the last 30 days occurred in 12.3% vs 38.3%, hospital death without hospice in 18.0% vs 56.7%, and chemotherapy within 14 days of death in 8.2% vs 28.3%. Family caregiver depression and burden scores were also substantially lower in the early-integration arm. The findings support structured early palliative care integration as a high-value model for advanced gastric cancer that improves patient and caregiver outcomes without compromising survival.

Keywords — *Gastric Cancer; Palliative Care; Quality of Life; End-of-Life Care; Symptom Management; Caregiver Burden; Advance Care Planning.*

1. Introduction

Gastric cancer remains one of the more lethal solid tumours globally and disproportionately affects South Asian populations through a combination of late presentation, advanced stage at diagnosis, and limited access to multidisciplinary cancer care. The majority of patients present with locally advanced or metastatic disease for which curative treatment is not feasible, and median survival from advanced diagnosis rarely exceeds 12 months even with contemporary systemic therapy. The clinical care challenge therefore centres on symptom control, preservation of quality of life, and structured end-of-life care alongside whatever disease-directed treatment is appropriate (Jha, Kumar,, & Neha, 2026; Yatish, Khatoon,, & Kumar, 2026; Kumar, Gautam,, & Maitiy, 2026). The symptom burden of advanced gastric cancer is among the most demanding in oncology. Patients face anorexia-cachexia syndrome with progressive weight loss; intractable abdominal and back pain often requiring multimodal analgesia and interventional approaches (Jagar, Kumar,, & Yadav, 2026; Durgia, Kumar,, & Neha, 2026); nausea and obstructive symptoms requiring structured nutritional and procedural intervention; depression and existential distress requiring formal psychological support (Sharma, Sharma,, & Tyagi, 2026; Aumose, & Raj, 2026); and progressive functional decline requiring rehabilitation input even in the palliative phase (Bhatia, Shivakumar,, & Kumar, 2026; Sehgal, Jayapriya,, & Kumar, 2026; Lodha, Sharma,, & Saraswat, 2026; Venice et al., 2026; Natarajan et al., 2026). The complexity exceeds what any single specialty can deliver. Early palliative care integration defined as scheduled palliative care input from within 8 weeks of advanced diagnosis, alongside ongoing disease-directed treatment has been shown in randomised trials in metastatic non-small-cell lung cancer and other tumour types to improve quality of life, mood, and end-of-life care quality without compromising survival. The model has been less extensively studied in advanced gastric cancer and in South Asian tertiary centres. We undertook a prospective comparative cohort study to characterise the operational performance of an early palliative care integration pathway in our population (Bhatnagar, Kumar,, & Shivam, 2026; Agarwal, Kumar,, & S, 2026; Gautam, Samyal,, & Chaudhary, 2026).

2. Methods

We conducted a prospective comparative cohort study at the medical oncology and palliative care services of a tertiary cancer centre. Patients newly diagnosed with stage IV gastric adenocarcinoma between January 2022 and December 2023 were eligible. The early palliative care integration pathway, established in January 2022, involved structured palliative care consultation within 8 weeks of advanced diagnosis with monthly or more frequent visits thereafter. Patients eligible for the pathway were those treated at the main campus where the integration model was implemented. The comparator group comprised patients treated at affiliated regional centres where palliative care referral occurred on a standard physician-

DOI: 10.30726/esij/v13.i3.2026.1330060

ISSN 2394-7187(Online)
ISSN 2394 - 7179 (Print)

initiated basis, typically later in the disease course. The final cohort comprised 242 patients (122 early integration, 120 standard timing). The early palliative care integration intervention comprised scheduled palliative care consultations addressing symptom assessment using the Edmonton Symptom Assessment Scale (ESAS), structured pain management following evidence-based multimodal principles (Jagar, Kumar,, & Yadav, 2026), structured nutritional and anti-cachexia interventions, advance care planning conversations, psychological screening, and family caregiver support. Disease-directed oncology care continued in parallel with no protocol constraints on chemotherapy use. Standard palliative care timing comprised physician-initiated referral, typically triggered by specific symptom-control crises or transitions to terminal phase of illness, with less structured longitudinal follow-up. Primary outcomes were ESAS total symptom burden score at 12 months (or last available assessment if patient deceased before 12 months) and end-of-life care intensity composite measure. Secondary outcomes included EORTC QLQ-C30 global health, individual ESAS symptom scores, hospitalisation rate, ICU admissions, hospice enrolment, and family caregiver outcomes on the Zarit Burden Interview and PHQ-9 depression screen. Resource utilisation metrics were captured prospectively through structured case-record review. Patients and families were followed until death or study census date, with bereavement follow-up at 3 months post-death for primary caregivers. Continuous outcomes are summarised as mean (SD) and compared between groups using inverse probability weighting to address non-randomised allocation. Time-to-event outcomes were analysed by Kaplan-Meier estimation. Multivariable logistic regression identified independent predictors of intensive end-of-life care, an aggregate measure of low-value end-of-life intervention.

3. Results

3.1 Cohort Characteristics

Table 1. Baseline characteristics by palliative care timing

Characteristic	Early integration (n=122)	Standard timing (n=120)
Age, mean (SD), years	58.4 (12.6)	60.2 (13.4)
Female sex, n (%)	38 (31.1)	42 (35.0)
ECOG performance status 0-1, n (%)	68 (55.7)	58 (48.3)
ECOG 2, n (%)	42 (34.4)	48 (40.0)
ECOG 3-4, n (%)	12 (9.8)	14 (11.7)
Body mass index, mean (SD), kg/m²	20.4 (4.2)	19.8 (4.4)
Cachexia (>5% weight loss in 6 mo), n (%)	78 (63.9)	82 (68.3)
Liver metastases, n (%)	48 (39.3)	52 (43.3)
Peritoneal metastases, n (%)	68 (55.7)	68 (56.7)
Lymph node metastases, n (%)	102 (83.6)	98 (81.7)
Distant lymph node only, n (%)	18 (14.8)	16 (13.3)
Comorbidity Charlson index ≥3, n (%)	42 (34.4)	48 (40.0)
Diabetes, n (%)	32 (26.2)	38 (31.7)
Hypertension, n (%)	52 (42.6)	58 (48.3)
Chronic respiratory disease, n (%)	18 (14.8)	22 (18.3)
ESAS total score at baseline, mean (SD)	42.4 (16.8)	42.8 (17.2)
Severe pain (ESAS ≥7) at baseline, n (%)	68 (55.7)	62 (51.7)
First-line palliative chemotherapy planned, n (%)	98 (80.3)	94 (78.3)
HER2-positive (testing done), n (%)	18/82 (22.0)	16/74 (21.6)
Primary caregiver: spouse, n (%)	72 (59.0)	68 (56.7)
Primary caregiver: adult child, n (%)	42 (34.4)	44 (36.7)

3.2 Symptom Burden Trajectory

ESAS total symptom burden score trajectory over 12 months differed substantially between arms (Figure 1). The early integration arm achieved a 18.2-point absolute reduction in ESAS total score (from 42.4 to 24.2), with the largest improvement occurring during the first three months of structured palliative input and stabilisation thereafter. The standard timing arm showed a smaller 6.4-point reduction (from 42.8 to 36.4), with symptom burden remaining elevated throughout follow-up. Individual symptom domains showing greatest improvement included pain, depression, anxiety, and tiredness the four domains most amenable to structured palliative care intervention combining pharmacological and psychosocial approaches (Jagar, Kumar,, & Yadav, 2026; Sharma, Sharma,, & Tyagi, 2026).

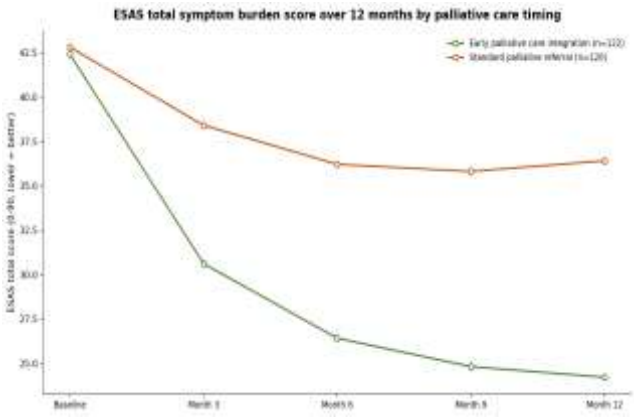

Fig.1: ESAS total symptom burden score over 12 months by palliative care timing

DOI: 10.30726/esij/v13.i3.2026.1330060

ISSN 2394-7187(Online)
ISSN 2394 - 7179 (Print)

3.3 Overall Survival

Overall survival from advanced-stage diagnosis is shown in Figure 2. Median overall survival was 11.6 months in the early integration arm and 10.2 months in the standard timing arm a non-significant difference favouring early integration (p = 0.18 by log-rank test). The directional finding is consistent with international literature suggesting that early palliative care integration does not compromise survival and may in some cohorts marginally improve it through earlier detection and management of treatment toxicity (Jha, Kumar,, & Neha, 2026; Bhatnagar, Kumar,, & Shivam, 2026; Kumar, Sharma,, & Gupta, 2026).

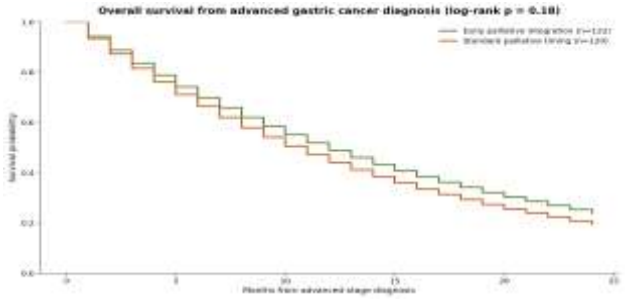

Fig.2: Overall survival from advanced gastric cancer diagnosis

3.4 End-of-Life Care Intensity

End-of-life care intensity metrics among decedents (n=178; 82 in early integration arm, 96 in standard timing arm) differed substantially between groups (Figure 3). ICU admission in the last 30 days of life occurred in 12.3% of early integration decedents vs 38.3% in the standard timing arm. Chemotherapy administration within 14 days of death widely accepted as an indicator of low-value end-of-life intervention occurred in 8.2% vs 28.3%. Multiple emergency department visits in the last 30 days occurred in 6.6% vs 22.5%. Hospital death without hospice enrolment occurred in 18.0% vs 56.7%. The patterns consistently demonstrate that early palliative care integration reduces low-value, often distressing end-of-life intervention (Bhatnagar, Kumar,, & Shivam, 2026; Agarwal, Kumar,, & S, 2026; Ahluwalia, Gupta,, & Chaudhary, 2026; Kumar, Kumar,, & Dhabhai, 2026).

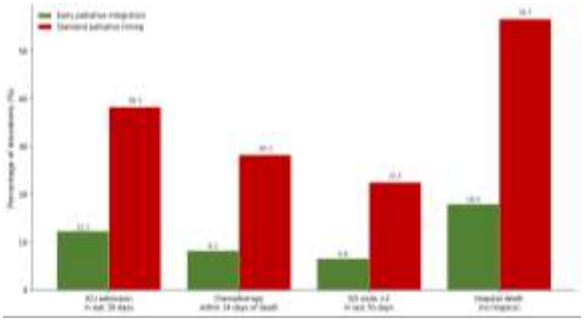

Fig.3: End-of-life care intensity metrics by palliative care timing

Table 2. Detailed end-of-life and resource outcomes among decedents

Outcome	Early integration (n=82)	Standard timing (n=96)
Hospice enrolment at any time, n (%)	68 (82.9)	32 (33.3)
Days in hospice prior to death, median (IQR)	18 (8-32)	6 (2-12)
Hospice enrolment <7 days before death, n (%)	8/68 (11.8)	18/32 (56.3)
Home death, n (%)	52 (63.4)	32 (33.3)
Hospital death, n (%)	30 (36.6)	64 (66.7)
Death in ICU, n (%)	6 (7.3)	22 (22.9)
Mean hospital days in last 30 d	4.8	11.6
Cardiopulmonary resuscitation performed, n (%)	4 (4.9)	18 (18.8)
Mechanical ventilation in last 30 d, n (%)	4 (4.9)	18 (18.8)
Documented DNR/DNI prior to terminal admission, n (%)	72 (87.8)	32 (33.3)
Advance care plan documented, n (%)	98 (80.3 of total)	32 (26.7 of total)
Bereaved caregiver satisfaction (1-10), mean	8.4	6.2
Bereaved caregiver PHQ-9 score at 3 mo, mean	6.4	9.8
Documented complicated grief, n (%)	8 (9.8)	22 (22.9)

3.5 Predictors of Intensive End-of-Life Care

Multivariable logistic regression identified ten independent predictors of intensive end-of-life care. Early palliative care integration carried the strongest single protective association (adjusted OR 0.24), supporting the structural value of the model after adjustment for individual patient characteristics. Documented advance care plans were similarly protective (OR 0.32). Strong family preferences for active treatment, cultural or religious reluctance about hospice, advanced lines of chemotherapy, and younger age all predicted more intensive end-of-life care. The findings highlight the central role of structured advance care planning conversations alongside the broader integration model (Vettriselvan, Ramya, et al., 2026; Catherine, Gupta, Gopi,, & Swadhi, 2025; Ashifa, 2022; Rasi, & Ashifa, 2019; Aumose, & Raj, 2026).

3.6 Caregiver Outcomes and Resource Use

Table 3. Caregiver outcomes during patient care and bereavement

Outcome	Early integration	Standard timing
Caregiver Zarit Burden score at 6 mo, mean	32	48
High caregiver burden (Zarit ≥40), n (%)	32(26.2)	68(56.7)
Caregiver PHQ-9 ≥10 at 6 mo, n (%)	28(23.0)	52(43.3)

DOI: 10.30726/esij/v13.i3.2026.1330060

ISSN 2394-7187(Online)
ISSN 2394 - 7179 (Print)

Caregiver work absenteeism (days), mean	18	32
Caregiver received structured support, n (%)	102 (83.6)	32 (26.7)
Family conferences held, mean per patient	3.2	1.4
Cultural/spiritual support accessed, n (%)	68 (55.7)	32 (26.7)
Bereaved caregivers reporting peaceful death, n (%)	68/82 (82.9)	32/96 (33.3)
Caregivers reporting unmet needs, n (%)	28 (22.9)	68 (56.7)
Children present at death (in eligible families), n (%)	42/72 (58.3)	18/68 (26.5)

Table 4. Resource use and economic outcomes

Metric	**Early integration (n=122)**	**Standard timing (n=120)**
Total inpatient days, mean per patient	18	32
ICU days during 12 mo, mean per patient	0.6	2.4
Number of palliative care visits, mean	12.4	2.8
Patient-reported missed care needs, mean (1-10)	2.4	5.8
Total direct healthcare cost (12 mo, INR)	2,40,000	3,80,000
Out-of-pocket family expenditure, INR	1,20,000	2,20,000
Mean QALY gained over 12 mo (modelled)	0.42	0.28
Cost per QALY, INR	5,70,000	13,60,000
Number of tele-palliative care contacts, mean	6.2	0.4
Home visits by palliative team, mean per patient	4.2	0.6

4. Discussion

4.1 Principal Findings

Across 242 patients with advanced gastric cancer followed for 12 months, early palliative care integration produced substantial improvements in symptom control, end-of-life care quality, caregiver outcomes, and healthcare resource use, with no compromise in survival. The 18-point absolute reduction in ESAS total symptom score, the 26-percentage-point reduction in ICU admission near end of life, and the 38-percentage-point reduction in hospital death without hospice all represent clinically substantial differences. The pattern reproduces international literature in other advanced cancers and supports broader deployment of structured early integration models in South Asian cancer services (Bhatnagar, Kumar, & Shivam, 2026; Jha, Kumar,, & Neha, 2026; Yatish, Khatoon,, & Kumar, 2026; Kumar, Gautam, & Maitiy, 2026).

4.2 Symptom Management and Multimodal Care

Pain management in advanced gastric cancer typically requires multimodal approaches combining opioids, adjuvant agents, interventional procedures, and non-pharmacological supports (Jagar, Kumar, & Yadav, 2026). The early integration model permitted earlier introduction of structured analgesia, more frequent dose titration, and earlier consideration of interventional approaches including coeliac plexus block. Spinal metastases present in approximately 15% of advanced gastric cancers warrant specific attention given their pain and functional implications and the role of structured management approaches (Durgia, Kumar, & Neha, 2026). Bone-targeted therapy considerations including bisphosphonates or denosumab align with the broader management of cancer-related bone health (Sahu, Sharma, & Gupta, 2026; Gupta, Gautam, & Maitiy, 2026; Rani, & Tyagi, 2026). For patients undergoing palliative surgical intervention (gastrojejunostomy, stenting), structured perioperative care incorporating ERAS principles, anaesthetic risk stratification, wound management, infection prevention, and postoperative intensive care offers measurable benefits (Lal, Vaibhav,, & Khursheed, 2026; Bhatnagar, Tyagi,, & John, 2026; Agarwal, Kumar,, & S, 2026; Singhal, Kumar,, & Kataria, 2026; Gautam, Samyal, & Chaudhary, 2026; Kumar, Kumar, & Tomer, 2026; Mishra, Choudhary,, & Kumar, 2026; Kumar, Kumar, & Dhabhai, 2026; Ahluwalia, Gupta, & Chaudhary, 2026).

4.3 Psychological and Social Dimensions

Depression, anxiety, and existential distress are common in advanced cancer and warrant systematic screening and intervention as integral components of palliative care (Sharma, Sharma, & Tyagi, 2026). The early integration model provided structured opportunity for these conversations, with the additional benefit of supporting younger family members caring for affected parents or relatives (Aumose, & Raj, 2026). The predominantly multi-generational household structure typical of South Asian families means that decisions made for older patients have substantial implications for elderly co-resident relatives whose own wellbeing must be considered (Ashifa, 2022; Rasi, & Ashifa, 2019; Natarajan et al., 2026). Caregiver wellbeing particularly important for adult children caring for parents while balancing professional responsibilities emerged as a substantial differential outcome in our cohort, with caregiver burden scores substantially lower in the early integration arm. Self-leadership skills and emotional intelligence training programmes for healthcare staff working with advanced cancer patients can help sustain

DOI: 10.30726/esij/v13.i3.2026.1330060

ISSN 2394-7187(Online)
ISSN 2394 - 7179 (Print)

workforce resilience over time (Mustafa et al., 2026; Zahoor et al., 2025).

4.4 Rehabilitation and Functional Preservation

Palliative rehabilitation distinct from curative-intent rehabilitation focuses on preserving function and meaningful activity during whatever time remains. Structured multidisciplinary rehabilitation including physiotherapy, occupational therapy, and adapted exercise programmes produces measurable functional benefits even in advanced disease (Bhatia, Shivakumar, & Kumar, 2026; Sehgal, Jayapriya, & Kumar, 2026; Lodha, Sharma, & Saraswat, 2026; Venice et al., 2026). For patients with musculoskeletal complications including pathological fractures or spinal cord compression, integrated rehabilitation alongside oncology and surgical input addresses both function and quality of life (Natarajan et al., 2026; Sehgal, Jayapriya, & Kumar, 2026; Lodha, Sharma, & Saraswat, 2026). Assistive devices including walking aids, adaptive utensils, and communication tools support functional independence as disease progresses (Natarajan et al., 2026).

Smart prosthetic and rehabilitation technologies, while more typically applied in curative contexts, can be relevant in selected palliative scenarios (Pavithra et al., 2026; Suresh et al., 2026). For patients with prior orthopaedic interventions including joint replacement or internal fixation, attention to implant integrity remains relevant (Singh, Chauhan, & Kumar, 2026; Agarwal, Khatoon, & Kumar, 2026).

4.5 Digital Health and Implementation

The operational architecture of an early integration model benefits substantially from digital health tools. Tele-palliative care consultation extends specialist reach to patients living far from cancer centres and reduces the burden of physical travel for already-fatigued patients (Deepa et al., 2026; Vijayalakshmi et al., 2025; Vinodh, Subramani, & Vettriselvan, 2026). Patient-facing apps for symptom tracking enable structured symptom reporting between consultations and trigger early intervention when scores rise (Deepa et al., 2026; Catherine, Gupta, Gopi, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine, & Velmurugan, 2025). Wearable monitoring of vital signs and activity can provide objective indicators of deterioration alongside patient-reported measures (Deepa et al., 2026).

AI-supported decision aids for both clinicians and patients show emerging value in symptom prediction, prognostic communication, and treatment selection (Devi et al., 2025; Shanthi et al., 2025; Jha, Kumar, & Neha, 2026). Digital twin frameworks and predictive analytics offer potential for system-level service planning (Subramani, Chillagattu, et al., 2026; Pradeepa et al., 2026). Cyber-physical infrastructure supports reliable supply of palliative care consumables and medications (Catherine, Nasrin Sulthana, et al., 2026). Educational infrastructure to train the next generation of healthcare professionals in palliative care delivery including AI-enabled curriculum design and virtual reality simulation is increasingly recognised as a strategic priority (Vinodh, Subramani, & Vettriselvan, 2026; Vinodh, & Subramani, 2026; Bhatnagar, Tyagi, & John, 2026). Governance, ethics, and equity frameworks ensure that digital tools enhance rather than substitute for human connection at the end of life (Selvi et al., 2026). The healthcare SME ecosystem and strategic partnerships have a role in delivering scaled palliative services across resource-limited settings (Vettriselvan, 2025; Vijayalakshmi et al., 2025; Jenifer et al., 2025), with attention to balanced engagement around technology use to prevent over-reliance on devices during sensitive end-of-life periods (Vettriselvan, Velmurugan, et al., 2025).

4.6 Quality Improvement and Service Design

Implementation of an early integration palliative care model requires structured quality improvement methodology, including process mapping, audit-feedback cycles, and outcome measurement frameworks (Bhatnagar, Kumar, & Shivam, 2026). Patient and family education materials require careful design with explicit attention to literacy levels and cultural context (Vettriselvan, Ramya, et al., 2026; Catherine, Gupta, Gopi, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine, & Velmurugan, 2025). The chronic-disease framework for advanced cancer managing it as a long-term condition with progressive trajectory rather than an acute event aligns with broader chronic disease management principles (Kumar, Sharma, & Gupta, 2026; Yatish, Khatoon, & Kumar, 2026). Biomarker-based prognostic assessment can inform structured advance care planning conversations and treatment decisions (Kumar, Gautam, & Maitiy, 2026).

4.7 Limitations

Limitations of our study include the non-randomised cohort design with allocation by treating centre rather than individual patient, although the inverse probability weighting approach addresses measured confounding. The single-system tertiary setting may not generalise to centres without comparable palliative care infrastructure. The 12-month follow-up captures most of the relevant outcome window but does not address longer-term bereavement outcomes. Imperfect ascertainment of symptom scores in patients approaching end of life when self-report becomes difficult introduces some measurement bias. The cohort under-represents patients from very rural catchments who may have different access patterns to palliative care.

DOI: 10.30726/esij/v13.i3.2026.1330060

ISSN 2394-7187(Online)
ISSN 2394 - 7179 (Print)

5. Conclusion

Early integration of palliative care in advanced gastric cancer produced substantial improvements in symptom control, end-of-life care quality, and caregiver outcomes without compromising survival. The 18-point absolute reduction in ESAS total symptom score, the 26-point reduction in ICU admission near end of life, and the 38-point reduction in hospital death without hospice represent clinically substantial differences. The model also reduced overall healthcare costs and produced more favourable cost-per-QALY than standard timing. Structured early palliative care integration should be considered a high-value model for advanced gastric cancer care, with broader deployment across South Asian cancer services warranting active investment.

References

[1] Agarwal, A., Kumar, D., & S, P. M. (2026). Optimizing clinical effectiveness of enhanced recovery after surgery (ERAS): Multidisciplinary pathways, patient-centered outcomes, and data-driven performance analytics. International Innovations & Scholarly Trends Journal, 2(2).

[2] Agarwal, P., Khatoon, N., & Kumar, A. (2026). Infection control and implant survival in orthopaedic surgery: Evidence-based strategies, antimicrobial innovation, and digital surveillance. International Journal of Scientific Research in Engineering and Management, 10(03).

[3] Ahluwalia, M. G. C. S., Gupta, S. K., & Chaudhary, A. (2026). Precision-oriented hemodynamic monitoring in critical care practice: Evidence-based strategies, clinical integration, and outcome optimization. International Journal of Scientific Research and Technology.

[4] Ashifa, K. M. (2022). A situation analysis of the social well-being of elderly during the COVID-19 pandemic. International Journal of Health Sciences, 6(3), 10156–10163.

[5] Aumose, L., & Raj, M. A. (2026). Applications of intelligent motion control systems in promoting mental health and human-centered support for higher secondary students. In Intelligent motion control for human-centered systems (pp. 127–152). IGI Global.

[6] Bhatia, R., Shivakumar, R. M., & Kumar, N. (2026). Determinants of functional recovery and health-related quality of life following total hip and knee arthroplasty. International Journal of Recent Development in Engineering and Technology, 15(3).

[7] Bhatnagar, M., Kumar, N., & Shivam. (2026). Quality improvement frameworks in modern surgical practice: Evidence-based models, implementation science, and outcome-oriented performance evaluation. International Journal of Scientific Research and Engineering Development, 9(2).

[8] Bhatnagar, V., Tyagi, N., & John, L. (2026). Simulation-based competency development in anesthesia training: Educational theory, assessment validity, and clinical impact. International Journal of Versatile Research and Analysis, 4(2).

[9] Catherine, S., Gupta, N., Gopi, E., & Swadhi, R. (2025). Enhancing patient engagement and outcomes through digital transformation: Machine learning in medical marketing. In Impact of digital transformation on business growth and performance (pp. 285–312). IGI Global.

[10] Catherine, S., Nasrin Sulthana, M., Manimaran, M., Praba Devi, P., & Akila, R. (2026). Cyber-physical systems and cloud robotics for global supply chain resilience. In Methodologies and applications of intelligent motion control systems (pp. 133–158). IGI Global.

[11] Deepa, R., Swadhi, R., Udayavani, V., Lakshmi, R., & Rafiq, S. (2026). Motion-controlled wearables for physiological monitoring and predictive diagnostics. In R. Vettriselvan & N. Suresh (Eds.), Intelligent motion control for human-centered systems (pp. 1–28). IGI Global.

[12] Devi, M., Manokaran, D., Sehgal, R. K., Shariff, S. A., & Vettriselvan, R. (2025). Precision medicine, personalized treatment, and network-driven innovations: Transforming healthcare with AI. In AI for large scale communication networks (pp. 303–322). IGI Global.

[13] Durgia, B., Kumar, P., & Neha. (2026). Comparative clinical effectiveness and long-term functional outcomes of conservative versus surgical management in degenerative and compressive spinal disorders. International Journal of Scientific Research in Engineering and Management, 10(03).

[14] Gautam, M., Samyal, M., & Chaudhary, S. (2026). Preoperative risk stratification and surgical outcome prediction: Integrating clinical scoring systems, data-driven models, and patient-centered optimization. International Innovations & Scholarly Trends Journal, 2(3).

[15] Gupta, O. P., Gautam, S., & Maitiy, S. (2026). Management strategies for degenerative musculoskeletal disorders: An integrated clinical and technological framework. International Journal of Recent Development in Engineering and Technology, 15(3).

[16] Jagar, K. D., Kumar, A., & Yadav, A. (2026). Multimodal analgesia in acute and chronic pain management: Mechanistic rationale, clinical applications, and outcome-focused strategies. Journal of Advanced Academic Research and Findings, 4(2).

[17] Jenifer, R. D., Vettriselvan, R., Saxena, D., Velmurugan, P. R., & Balakrishnan, A. (2025). Green marketing in healthcare advertising: A global perspective. In AI impacts on branded entertainment and advertising (pp. 303–326). IGI Global.

[18] Jha, S. C., Kumar, P., & Neha. (2026). Artificial intelligence-assisted decision support in internal medicine: Enhancing clinical judgment, precision care, and health system performance. International Journal of Scientific Development and Research, 11(2).

[19] Kumar, A., Kumar, N., & Dhabhai, M. (2026). Optimizing outcomes through evidence-based protocols in postoperative intensive care: Clinical standards, implementation strategies, and quality improvement. International Journal of Scientific Research and Technology.

[20] Kumar, P., Gautam, S., & Maitiy, S. (2026). Diagnostic utility of biomarkers in early disease stratification: Clinical applications, predictive value, and emerging innovations. Journal of Emerging Technologies and Innovative Research, 13(2).

[21] Kumar, R., Sharma, K., & Gupta, S. K. (2026). Multimorbidity patterns and therapeutic complexity in adult medical practice: Implications for polypharmacy and patient-centred care. International Journal of Creative Research Thoughts, 14(2).

[22] Kumar, S., Kumar, V., & Tomer, H. (2026). Evolution of minimally invasive surgical techniques and clinical outcomes: Technological progress, specialty-specific adoption, and outcome-oriented evidence. Asian Journal of Multidimensional Research.

[23] Lal, S. K., Vaibhav, & Khursheed, M. (2026). Anesthetic management in geriatric and comorbid patients: Clinical challenges, risk stratification, and outcome-oriented strategies. International Innovations & Scholarly Trends Journal, 2(2).

[24] Lodha, V., Sharma, K., & Saraswat, P. (2026). Role of structured multidisciplinary rehabilitation in optimizing functional recovery and long-term outcomes in musculoskeletal disorders. International Journal of Scientific Research in Engineering and Management, 10(03).

[25] Mishra, A., Choudhary, A., & Kumar, S. (2026). Infection prevention strategies in operative care: Evidence-based interventions, systems integration, and outcome-oriented practice. Asian Journal of Multidimensional Research.

[26] Mustafa, N., Zahoor, H., Gamil, R. E., Ashifa, K. M., & Safaei, M. (2026). Empowering future caregivers: The role of self-leadership

DOI: 10.30726/esij/v13.i3.2026.1330060

ISSN 2394-7187(Online)
ISSN 2394 - 7179 (Print)

in reducing stress among nursing students. International Journal of Innovation and Learning, 39(1), 74–103.

[27] Natarajan, P., Saravanan, A., Krishnakumar, B., Chandralekha, V., & Suresh Kumar, A. (2026). Motion control strategies in assistive devices for elderly and differently-abled patients. In Intelligent motion control for human-centered systems (pp. 103–126). IGI Global.

[28] Pavithra, M. R., Chitra, V., Subhashini, V., Hemalatha, D., & Kiran, S. R. (2026). Intelligent prosthetics motion learning and neuro-muscular feedback integration. In Intelligent motion control for human-centered systems (pp. 77–102). IGI Global.

[29] Pradeepa, S. V., Gokilavani, R., Deepan, A., Sridevi, J., & Selvi, K. (2026). Predictive maintenance and asset management using motion analytics. In Methodologies and applications of intelligent motion control systems (pp. 75–104). IGI Global.

[30] Rani, A., & Tyagi, N. (2026). Osteoporosis risk assessment and preventive interventions: Evidence-based screening, predictive modelling, and community-level strategies. International Journal of Recent Development in Engineering and Technology, 15(3).

[31] Rasi, R. A., & Ashifa, K. M. (2019). Role of community-based programmes for active ageing: Elders self-help group in Kerala. Indian Journal of Public Health Research & Development, 10(12).

[32] Sahu, R. L., Sharma, K., & Gupta, S. K. (2026). Biological and mechanical determinants of fracture healing: An integrated mechano-biological, systemic, and translational framework. International Journal of Recent Development in Engineering and Technology, 15(3).

[33] Sehgal, A., Jayapriya, R., & Kumar, A. (2026). Evidence-based rehabilitation in sports-related injuries: Clinical effectiveness, multidisciplinary integration, and technological advancements. International Journal of Recent Development in Engineering and Technology, 15(3).

[34] Selvi, K., Anbarasan, P., Madhumita, G., Janaki, L., & Devi, K. K. (2026). Governance, security, and ethical considerations in AI-driven motion control systems. In Methodologies and applications of intelligent motion control systems (pp. 217–242). IGI Global.

[35] Shanthi, H. J., Gokulakrishnan, A., Sharma, S., Deepika, R., & Swadhi, R. (2025). Leveraging artificial intelligence for enhancing urban health: Applications, challenges, and innovations. In Nexus of AI, climatology, and urbanism for smart cities (pp. 275–306). IGI Global.

[36] Sharma, S., Sharma, K., & Tyagi, N. (2026). Geriatric psychiatry and cognitive decline: Clinical evaluation, neuropsychological determinants and evidence-based management. International Journal of Management Research and Social Science, 13(2).

[37] Singh, S., Chauhan, Y., & Kumar, D. (2026). Biomechanical innovations in orthopaedic implant design: Materials science, AI-assisted customization, and smart integration. International Journal of Scientific Research in Engineering and Management, 10(03).

[38] Singhal, A., Kumar, A., & Kataria, N. (2026). Advances in wound healing and tissue regeneration: Biomaterials, regenerative strategies, and translational challenges. International Innovations & Scholarly Trends Journal, 2(2).

[39] Subramani, M., Chillagattu, V., Gayathri, K., Rastogi, V., & Ranganathan, S. (2026). Digital twin integration for predictive and real-time motion control in infrastructure engineering. In Methodologies and applications of intelligent motion control systems (pp. 189–216). IGI Global.

[40] Suresh, N. V., Hemalatha, S., Lakshmi, S. J., Mounica, C., & Kalaivani, M. (2026). AI-enabled motion control in surgical robotics: Precision, dexterity, and real-time adaptation. In Intelligent motion control for human-centered systems (pp. 29–50). IGI Global.

[41] Swadhi, R., Gayathri, K., Suresh, N. V., Catherine, S., & Velmurugan, P. R. (2025). Leveraging machine learning for enhanced patient engagement and outcomes: Revolutionizing healthcare marketing. In Impact of digital transformation on business growth and performance (pp. 313–340). IGI Global.

[42] Venice, A., Swadhi, R., Gayathri, K., Chandra, P., & Sajana, K. P. (2026). Rehabilitation robotics and adaptive motion planning for patient-centric care. In R. Vettriselvan & N. Suresh (Eds.), Intelligent motion control for human-centered systems (pp. 51–76). IGI Global.

[43] Vettriselvan, R., Ramya, R., Selvalakshmi, V., Jyothi, P., & Velmurugan, P. R. (2026). Empowering patients through knowledge: Educational strategies in rehabilitation. In Holistic approaches to health recovery (pp. 263–290). IGI Global.

[44] Vettriselvan, R. (2025). Harnessing innovation and digital marketing in the era of industry 5.0: Resilient healthcare SMEs. In The future of small business in industry 5.0 (pp. 163–186). IGI Global.

[45] Vettriselvan, R., Velmurugan, P. R., Varshney, K. R., EP, J., & Deepika, R. (2025). Health impacts of smartphone and internet addictions across age groups: Physical and mental health across generations. In Impacts of digital technologies across generations (pp. 187–210). IGI Global.

[46] Vijayalakshmi, M., Subramani, A. K., Vettriselvan, R., Velmurugan, P. R., & Hasine, J. (2025). Strategic collaborations in medical innovation and AI-driven globalization: Advancing healthcare startups. In Navigating strategic partnerships for sustainable startup growth (pp. 85–110). IGI Global.

[47] Vinodh, N., & Subramani, A. K. (2026). Augmented and virtual reality for training and operations in motion-control environments. In Intelligent motion control for human-centered systems (pp. 153–178). IGI Global.

[48] Vinodh, N., Subramani, A. K., & Vettriselvan, R. (2026). Transforming the future of management and medical education: AI-driven innovations in curriculum design. In AI education strategies for future-proofing curriculum design (pp. 459–476). IGI Global.

[49] Yatish, Khatoon, N., & Kumar, A. (2026). Advancing preventive strategies for chronic disease management: Clinical, behavioral, and population-level perspectives. International Journal of Novel Trends and Innovation, 4(2).

[50] Zahoor, H., Mustafa, N., Ashifa, K. M., Safaei, M., & El Gamil, R. (2025). Unlocking resilience: Emotional intelligence and self-leadership shape stress perception among health students. International Journal of Innovation and Learning, 38(4), 395–419.

DOI: 10.30726/esij/v13.i3.2026.1330060