Linking Palliative Homecare to the Universal Health Coverage Principles and the United Nations Sustainability Development Goals Using the i* Framework's Strategic and Social Requirements Modelling, Applied to a Cancer Care Organisation

Yousra Odeh
Software Engineering Department, Philadelphia University, Jordan

Dina Tbaishat
College of Technological Innovation, Zayed University, UAE
University of Jordan, Jordan

Faten F. Kharbat
College of Engineering, Al Ain University, UAE

Omar Shamieh
Department of Hospice, Palliative Care, King Hussain Cancer Centre, Jordan
Faculty of Medicine, University of Jordan, Jordan

Mohammed Odeh
Cancer Care Informatics Directorship, King Hussain Cancer Centre, Jordan
Faculty of Environment and Technology, University of West of England, UK
Global Academy for Digital Health, UK

Abstract: *Adherence to the Universal Health Coverage (UHC) principles in relation to palliative care is a key WHO directive to attain as a right for every citizen. However, UHC principles have been observed to be hindered by several barriers. Moreover, the UNSDGs, and in particular the UNSDG 3, demands "Good Health and Well Being" with the two key indicators UNSDG 3.8.1 and 3.8.2 that can be considered as metrics to assess governance conformance to palliative care. This paper reports on addressing the current research gap in linking the UHC principles to UNSDGs and, in particular, UNSDG3 and the WHO identified Palliative Care Barriers (PCB) using the i* framework Strategic Dependency (SD) and Strategic Rationale (SR) models applied to Home Healthcare Care (HHC) of a regional cancer care organisation, namely King Hussain Cancer Center (KHCC). Building on our i* HHC SD and SR developed models, and for HHC being an essential and critical part of palliative care, an integrated framework has been developed that not only links UHC principles and WHO barriers of palliative care to UNSDG 3, but a full network of dependencies that facilitates observing the linkages and impact of the most critical and strategic actors in HHC on the UHC, barriers to palliative care and UNSDG 3. Furthermore, such highly comprehensive UHC-PCB-UNSDG-i* framework network instantiations have led to identifying patterns of categories or groups of associations between UNSDG3 KPIs, UHC principles, WHO PCB and HHC actors. Hence, this contributes to healthcare policy and decision makers to revisit their policies, plans, budgets, and constraints for the deficiencies in the qualitative satisfaction of the UHC principles and how PCB can be alleviated in association with the actors in the i* SD and SR models and associated goals, tasks and resources. A further corollary of this research is that change impact analysis can be timely attained to study the impact of a change driven by updating goals, tasks, and resources of the i* model to improve adherence to the UNSDG3 KPIS and UHC principles. Finally, this work has inspired work in progress to develop a data analytics platform from the evolving instances of applying palliative care processes using the resultant UHC-PCB-UNSDG-i* framework.*

Keywords: *Universal health coverage, UNSDGs, i* framework, home health care, palliative care, goal-oriented modelling, social requirements modelling, cancer care process modelling, cancer care informatics, cancer care sociotechnical systems.*

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1. Introduction

The Universal Health Coverage (UHC) directive of the WHO in relation to palliative care, as a right for every citizen, set a number of palliative care principles that have been observed by the WHO to be hindered by several barriers [15]. This research is an attempt to address the current research gap in linking the UHC principles and WHO Palliative Care Barriers (PCB) to UNSDGs and, in particular, UNSDG3 UNSDG 3 "Good Health and Well Being" [22] to our i* framework Strategic Dependency (SD) and Strategic Rationale (SR) models. These models were developed in ACTIT 2022 [21] paper entitled "Critical analysis of palliative homecare using the i* framework's strategic and social requirements modelling applied to a cancer care organisation with its application to the Home Healthcare Care (HHC) of a regional cancer care organisation,

namely King Hussain Cancer Center (KHCC)". Building on our i* HHC SD and SR developed models, and for HHC being an essential and critical part of palliative care (and more demanding the case for terminal cancer patients), an an integrated framework has been developed that not only links UHC principles and WHO barriers of palliative care to UNSDG 3, but provides a full network of dependencies that facilitates observing the linkages and impact of the most critical and strategic actors in HHC on the UHC, barriers to palliative care and UNSDG 3.

The need for palliative care is increasing globally and most patients with life-limiting conditions including cancer and other chronic diseases, require palliative care [11]. HHC is an essential part in which patients are visited in the comforts of their homes aiming at relieving or preventing suffering. The visits can be made at any stage including for patients with life-limiting illnesses who choose to receive care and die at home. A comprehensive healthcare framework that shifts patient palliative care from hospital to home has been a topic of interest for practitioners, researchers, patients, and their families, yet it is still challenging to achieve [12]. In Jordan, cancer care centres have put great efforts into increasing awareness of palliative care at home with the presence of continuous economic challenges [21]. This suggests evolving current palliative homecare practices and services with lessons reflectively learned from the Covid-19 pandemic and the paramount importance of palliative home care. Providing person-centered home-based palliative care can improve health outcomes and reduce patient depression and operating palliative care costs [19].

To develop systems that empower HHC, it is necessary to obtain an understanding of the motivation and rationale behind HHC activities at the very early stage of applying HHC-driven requirements engineering process aiming at specifying the requirements for evolving the current systems to meet the home-patient quality of in person's life centred care. However, the success of this development relies on factors that are related to organisational strategies, processes, policies, quality requirements, and associated enactment environment. The i* framework [6] is proposed to provide a rich description of human social organisations showing their intentions and motivational interactions through a network of dependencies. We hypothesise that the domain of palliative care contextually benefits from the application of i* framework [21], as palliative care involves heavy interactions and coordination between many interdisciplinary professionals. This paper presents the strategic model views (SD and the SR), using the i* framework, for the current HHC process of palliative care at a regional cancer centre, namely KHCC in Jordan. The paper is organised as follows: Section 2 provides background in relation to HHC in palliative care and i* Framework as a goal-oriented method, Section 3 presents a strategic model view of the HHC process in KHCC, and Section 4 reports on the detailed linking of the UHC principles, WHO palliative barriers and UNSDG 3 to the i* models of palliative care (and mainly the HHC KHCC case study). Section 5 provides critical insights into the dependency network resulting from linking UHC principles, WHO palliative barriers and UNSDG 3 to our HHC developed i* SD and SR models with observations on the application of the i* framework to HHC context of palliative care. Finally, conclusions are drawn in Section 6.

2. Background

2.1. Home Health Care (HHC)

Many patients suffering from cancer or other chronic diseases with life-limiting conditions need home palliative care. HHC is an essential component of palliative care where services are delivered in the comfort of the patient's home. It aims to improve the quality of life for patients and their families. Not all patients requiring the service actually get it through [11]. Although there is a growing need for palliative care, only 14% of patients worldwide receive this service [19]. In a Canadian study [3], it is predicted that by 2056 the number of Canadian deaths will rise to 480,000 per year with 90% of those deaths being eligible for palliative care.

Hofmeister et al. argue that the provision of palliative care in the home varies in terms of the providers offering the interventions, the components of care, and the target recipients [10]. A Cochrane review of home-based palliative care for patients and their caregivers resulted in a positive impact on symptoms' burden, but no effect on caregiver grief compared to usual care [8]. In another review, regular collaboration with medical consultants and professionals, mobility assistance, illness progression information, financial support, and spiritual needs were not addressed specifically within the homecare palliative care context [24].

In Jordan, KHCC runs the palliative home care program - considered the largest one in the country [4] where two teams manage this service and operate five days a week - weekend visits are arranged upon request. One team covers patients in Amman (the capital), while the other team covers areas outside Amman within a 100-mile radius. The resources allocated for each team are composed of the following: two nurses, a driver, and a dedicated car. The services provided include nursing assessment and care, pain and symptoms assessment and management, counselling, end-of-life care, phlebotomy, and intravenous antibiotics if needed [19]. There is a consultant physician responsible for overseeing these teams and the associated palliative care services. As part of the home care service - in addition to patient visits - the teams make visits to families within the first week of the patient's death. The number of

patient visits is determined according to the patient's needs.

2.2. The i* Framework Goal-Oriented Modelling Method

Anton et al. business goals are defined as "high-level objectives of the business, organisation or system that capture the reason why a system is needed and guide decisions at various levels within enterprise" [2]. Franch et al. argue that goals can be at a high level of abstraction at a strategic level or as detailed at a technical level, acting as essential artefacts early in the requirements engineering process [6]. Therefore, goals act as a basis for deriving designs, examples of such approaches as surveyed in [9]. Goal-oriented approaches are also popular in other fields such as organisational modelling and in driving software architecture specifications [6].

The i* framework [6] is considered one of the most popular goal-oriented and agent-oriented modelling methods, bridging the gap between sociotechnical systems and organisations [25]. It is an approach aimed at understanding the problem space of a business organisation early enough during the requirements engineering process [13]. The i* framework embraces the concepts of actor, dependency, goal, and decomposition. It supports a network of autonomous dependable collaborative actors [6]. The i* framework has been adopted in this research to develop goal-oriented models of HHC as it aligns with the research gap in modelling the social requirements of the palliative care process and the HHC process in particular, let alone addressing the satisfaction of the goals of HHC in relation to the respective enactment of the healthcare provider information systems.

The i* framework supports two types of strategic models: the SD and the SR models. The SD model presents a network of dependencies with external relationships between actors, in which the depender depends on a dependee to achieve a dependum, whether it is a goal, soft goal, task, or resource [25]. A goal is usually a functional requirement (such home care visit attained), whereas a soft goal is a non-functional requirement (such as confidentiality, safety, etc). A task represents an action to be performed, whereas a resource is the means to achieve these other concepts (e.g. patient file, physician report, etc). The SR model develops the abstracted SD model by modelling internal relationships associated with actors using means-end and task decomposition links, for more holistic modelling of actor-associated requirements. Actors can be human or otherwise; they are active entities that either hold intentions to attain dependums and/or abilities to achieve them. The i* framework was first adopted in the domain of cancer care, where goal-oriented models of the cancer care and registration processes of KHCC were used to drive the process of developing process architecture and software services in the Cancer Care and Registration case study process [14]. A further i* framework study was followed in the systems of systems context with the development of a goal-oriented referential integrity model [20].

3. The i* Strategic Models of the KHCC HHC Process

Both the SD model and its reflective SR model for HHC process at KHCC have been developed using the i* 2.0 standard depicted in Figures 1 and 2 as shown in [21]. A special-purpose requirements elicitation has been followed to develop these models, where the literature has been investigated, along with the documents of the associated validated palliative care process models at KHCC. The Pistar tool is used for visualisation [17]. In the SD model, as in Figure 1, seven strategic social actors do not exist in isolation, but they depend on each other to deliver patient home-based palliative care services. Eight dependencies are identified between those seven actors; four goal dependencies, three task dependencies, and one resource dependency. An example of goal dependency in Figure 1 is having the patient care Clinical Nurse Coordinator (CNC) depending on the patient care consultant for the goal "patient need for HHC is evaluated". Therefore, the patient care CNC relies on the patient care consultant to achieve this goal as the latter knows the "how aspects" and is assumed to provide effective execution as the designated actor in this context. The HHC nurse depends on the HHC specialist to run the discussion of the sign-off meeting; this is a task dependency where the HHC nurse is aware of how this task is to be carried out including associated discussions of the palliative patient case. The social worker requires an order recommendation as an informational entity from HHC specialist. This is an example of a resource dependency association. However, it appears that no soft goal dependencies can be inferred and hence this suggests a further revisit of the documentation of the HHC process ought to be attained.

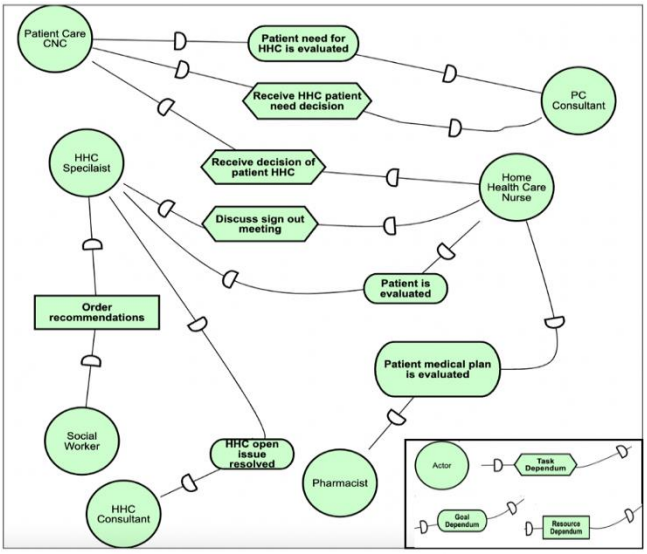

Figure 1. The SD model for HHC.

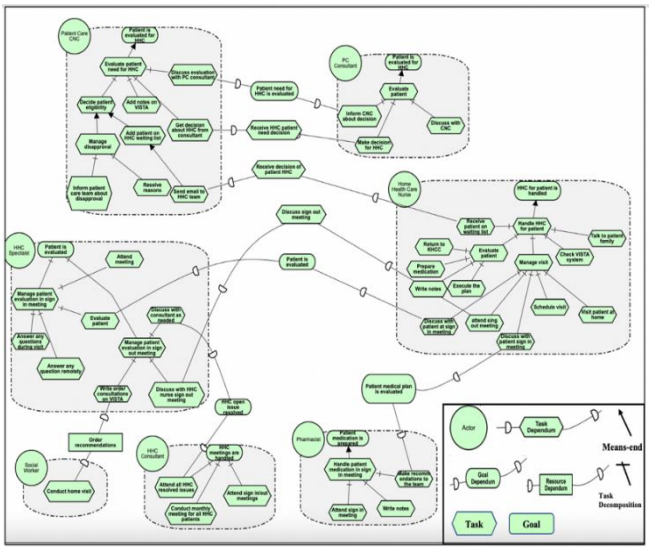

Figure 2. The SR model for HHC.

The HHC SR model elaborates the SD model, as shown in Figure 2 Within each actor's boundary, there is a goal that represents the actor's ability. This ability is elaborated into associated tasks through any of the two types of relations; means-end or task decomposition. For example, the patient care consultant has the ability to evaluate the patient for HHC. Thus, the task "evaluate patient" acts as a means to realise/achieve the associated goal. This task is decomposed into three sub-tasks that altogether contribute to fulfilling the parent task satisfaction. These offspring tasks are: to inform CNC about the decision, make the decision for HHC, and discuss the case with CNC.

4. Linking UHC Principles, WHO Palliative Care Barriers, and UNSDG 3 to i* Models of Palliative care (the HHC Case Study)

The WHO stresses on the delivery of palliative care with adherence to the following requirements of the *UHC* [23], which we have been articulated into three distinct principles, P1, P2, and P3 as follows:

- **UHC.P1:** "All people, irrespective of income, disease type or age, should have access to a nationally-determined set of basic health services, including palliative care."
- **UHC.P2:** Covering "the full continuum of essential health services, from health promotion to prevention, treatment, rehabilitation, and palliative care across the life course."
- **UHC.P3:** "Financial and social protection systems need to take into account the human right to palliative care for poor and marginalized population groups."

However, the WHO identifies key barriers [15] that hinder the delivery of palliative care which we have reformulated and specified below as PCB PC.B1 - PC.B8:

- PC.B1: Palliative care policies are not explicitly (or in some cases not in existence) integrated into the national healthcare policies and systems.
- PC.B2: Limited or non-existing palliative care training of healthcare staff.
- PC.B3: Limited access, beyond international conventions, to opioids for pain relief as key patients' right for "access to essential medicines".
- PC.B4: Limited or no funding for palliative care.
- PC.B5: Limited awareness and benefits of palliative care amongst policy makers, healthcare workers, and the public.
- PC.B6: Cultural and social perceptions in relation to end of life
- PC.B7: Wrong perceptions that palliative care is for just about to die patients
- PC.B8: Wrong perceptions that wider access to opioids for palliative care patients can lead to opioids be misused.

Furthermore, the WHO has provided two key measurements for achieving UHC in light of the 17 United Nations Sustainability Development Goals (UNSDGs) [22] and in particular UNSDG 3 in relation to "Good Health and Well Being" [18]. These two measurements or key indicators under UNSDG 3 have been identified as palliative care related, but they have not been provided with detailed measurements contextually with palliative care [7, 5]:

- UNSDG3.8.1: "Coverage of essential health services, (defined as the average coverage of essential services based on tracer interventions that include reproductive, maternal, new-born and child health, infectious diseases, non-communicable diseases and service capacity and access, among the general and the most disadvantaged population)" [5].
- UNSDG3.8.2: "Number of people covered by health insurance or a public health system per 1,000 population" [5] which reflects on health spending being within the catastrophic boundary or not.

Table 2. Linking UNSDG3, WHO UHC Principles, and WHO Palliative Care Barriers to i* SD Model of Palliative Homecare in a Cancer Care Organization.

Actors in i* SD Model	Association with Goal Dependency	Association with Task Dependency	Association with Resource Dependency	Affected Actor in the i* SD Model	Dependency on UHC Principle	Affected UN Palliative Care Barrier	UNSDG KPI
Patient Care CNC	Patient need for HHC is evaluated	Receive HCC Patient Need Decision	None	PC Consultant	UHC.P1 UHC.P2	PC.B1 PC.B5 PC.B6	UNSDG3.8.1
PC Consultant	Patient need for HHC is evaluated	Receive HCC Patient Need Decision	None	Patient Care CNC	UHC.P1 UHC.P2	PC.B1 PC.B5 PC.B6	UNSDG3.8.1
Patient Care CNC	None	Receive Decision of Patient HCC	None	Home Healthcare Nurse	UHC.P2 UHC.P3	PC.B1 PC.B2 PC.B4 PC.B5 PC.B6	UNSDG3.8.1
Home Healthcare Nurse	None	Receive Decision of Patient HCC	None	Patient Care CNC	UHC.P2 UHC.P3	PC.B1 PC.B2 PC.B4 PC.B5 PC.B6	UNSDG3.8.1
Home Healthcare Nurse	None	Discuss Signing Out Meeting	None	HHC Specialist	UHC.P2 UHC.P3	PC.B1 PC.B2 PC.B4	UNSDG3.8.1
Home Healthcare Nurse	Patient is Evaluated	None	None	HHC Specialist	UHC.P2 UHC.P3	PC.B1 PC.B2 PC.B4	UNSDG3.8.1
HHC Specialist	None	Discuss Signing Out Meeting	None	Home Healthcare Nurse	UHC.P1 UHC.P2 UHC.P3	PC.B1 PC.B2 PC.B4	UNSDG3.8.1
HHC Specialist	Patient is Evaluated	None	None	Home Healthcare Nurse	UHC.P1 UHC.P2 UHC.P3	PC.B1 PC.B2 PC.B4	UNSDG3.8.1
Home Healthcare Nurse	Patient Medical Plan is Evaluated	None	None	Pharmacist	UHC.P1 UHC.P2	PC.B1 PC.B2 PC.B3 PC.B4 PC.B8	UNSDG3.8.1 UNSDG3.8.2
Pharmacist	Patient Medical Plan is Evaluated	None	None	Home Healthcare Nurse	UHC.P1 UHC.P2	PC.B1 PC.B2 PC.B3 PC.B4 PC.B8	UNSDG3.8.1 UNSDG3.8.2
HHC Specialist	HHC Open Issue Resolved	None	None	HHC Consultant	UHC.P1 UHC.P2 UHC.P3	PC.B1 PC.B2 PC.B4	UNSDG3.8.1
HHC Specialist	None	None	Order Recommendation	Social Worker	UHC.P1 UHC.P2	PC.B1 PC.B2 PC.B4	UNSDG3.8.1
HHC Consultant	HHC Open Issue Resolved	None	None	HHC Specialist	UHC.P1 UHC.P2 UHC.P3	PC.B1 PC.B2 PC.B4	UNSDG3.8.1
Social Worker	None	None	Order Recommendation	HHC Specialist	UHC.P1 UHC.P2	PC.B1 PC.B2 PC.B4	UNSDG3.8.1

We have developed a novel framework, namely UNSDG.UHCP.PCB, to derive linking the i* SD model (and then to the i* SR model) to the United Nations Sustainability Developing Goal 3 (UNSDG3 in relation to "Good Health and Well Being"), the articulation of the WHO Universal HealthCare principles (UHC.P), and UN PCB as can be depicted in Figure 3.

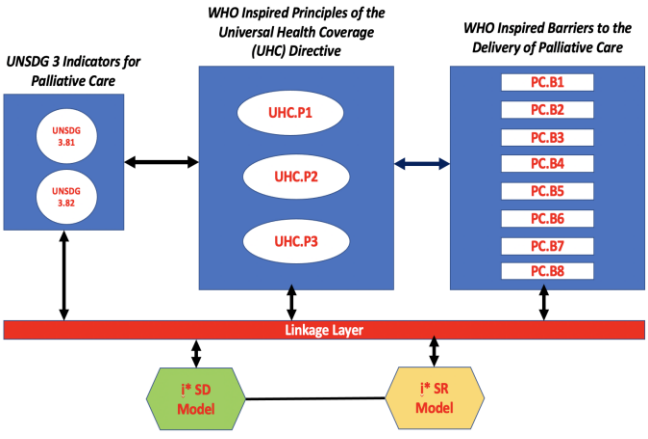

Figure 3. The UNSDG.UHCP.PCB Linkage Framework.

The UNSDG.UHCP.PCB framework has been applied to the Palliative Homecare case study undertaken in this research in KHCC as the Cancer Care Organization, with the results of this application instantiated in Table 2. It can be observed (in Table 2) that the actors' associations in the SD model (of Figure 1) have been traversed while tracing their dependencies with other actors through associated goals, tasks, and/or resources. This has facilitated forward and backward traceability from UNSDG3 KPIs to UHC.Ps (Universal Health Care Principles) to PCBs to the elements of the i* SD model, and vice versa. This refelects on the i* SD model in demonstrating the significance of this linkage when it is fully expanded with other i* models such as the SR model linked by the respective actors for example in Figure 2.

5. Discussion

This section provides critical observations on the application on:

1. The i* framework along with its strategic model views in HHC context of social requirements modelling of palliative care,
2. Linking the i* framework to UNSDGs goals through UNSDG3 to the *I framework through the SD model acting as the elaboration bridge to the SR model.

(1) The i* Framework of Palliative Homecare in the Context of a Cancer Care Organization.

It is now possible for palliative care domain experts in the HHC process and using the associated SD model (Figure 1) to identify the most critical and strategic actors in the HHC process by pinpointing the highly interacting dependers and dependees, where they can be observed having highest participation value as shown in Table 1. For example, in Figure 1, it appears that the HHC specialist is the most critical actor due to its participation in three dependency relationships as a dependee and in one dependency relationship as a depender. Hence, the HHC specialist is heavily acting as a dependee when handling the HHC process; and thus, this provides the means to assess and monitor the effectiveness of the associate HHC process from this perspective, for example, that can be a performance measurement means by the respective HHC management. Also, the HHC nurse is heavily acting as a depender due to its participation in 4 relationships as a depender. Thus, it can be claimed that HHC nurse is highly vulnerable actor in the HHC process, another performance-monitoring target for the HHC management.

Table 1. The participation of actors as dependers and dependees.

Actor	Acting as Depender	Acting as Dependee
Patient Care CNC	1	2
PC Consultant	0	2
HHC Specialist	1	3
Home Health Care Nurse	4	0
Pharmacist	0	1
HHC Consultant	0	1
Social Worker	1	0

This reflects on the critical role of the HHC SD model in assisting HHC decision makers for the most effective management of HHC resources, and of paramount importance for the critical HHC strategic actors to mitigate/minimise any potential serious consequences should any HHC critical actor fails to timely attain or deliver a dependum. Assessing the extent of the criticality of strategic actors can be further inspired by the field of business process modelling by calculating coupling factors for each role in a given process, informing the actors' coupling complexity of actor, being highly or loosely coupled for example [16].

The SR model, on the other hand, contributes to informing heavily task-loaded strategic actors where these tasks may consume significant resources (as time units) that are not necessarily efficiently utilised. Therefore, the SR model induces paying higher attention to facilitating resources and/or conducting improvement in order to mitigate risks associated with each task and actor; for example, the HHC specialist having the highest number of dependee relationships-3 must be provided with resources to enable them to perform their tasks as efficiently and effectively prescribed.

Furthermore, using both the SD and SR models enables *strategic-based forward and backward traceability* through the use of directed strategic relations of the HHC process, which are represented either as dependencies in the SD model or as task decomposition and means-end relationships in the SR model. Forward traceability in the SD model is shown in each dependency that is directed from the depender to the dependee. Forward traceability assists HHC domain experts in indicating the criticality of a palliative actor as depender, which in turn informs the dependee's centralisation. On the other hand, backward traceability is the reverse direction of an HHC SR relationship in the same SD model. This kind of traceability is necessary to inform an HHC depender about consequences resulting from a set of reconfigurations taking place for maintainability purposes at the dependee's boundary. For example, in the HHC SR model, in one relationship the HHC nurse depends on the specialist, and hence if any change in the task "evaluate patient" occurs, this will result in changes to the task "discuss with the patient at sign in meeting".

At the SR model level, forward traceability appears in the task decomposition relationship from a parent task

to the respective sub-tasks, sub-goals, sub sub-soft goals or sub resources. This may direct the HHC management to measure the complexity of a parent task. The more sub-elements identified (or the deeper the specialisation of sub elements in the SR model) for a parent task in a decomposition relationship, the more it gets complex to maintain and a certain the satisfaction of the parent HHC goal or soft goal. Forward traceability is also represented from the mean to the end. This can assist HHC domain experts in exploring further means alternatives for an end between HHC dependers and dependees, and this allows tailoring the means with respect to current HHC conditions and needs. The corresponding backward traceability is the reverse direction of both relations in the same SR model. It contributes to assisting HHC domain experts in rationalising each HHC process element identified in the boundary of participating HHC.

Overall, the SR model contributes to getting insights about behavioral and non-behavioral elements that are considered essential for HHC process. In social requirements modelling, these elements are represented as intentions and motivations within an actor boundary. For example, the HHC specialist has the intention of having a patient evaluated. An intention may remain; however, alternatives may vary for fulfilling it. This facilitates HHC domain experts in evolving the potential palliative care alternatives.

Furthermore, one significant missing aspect in the current KHCC HHC i* SD and SR models is the consideration of the desired quality requirements represented in the form of soft goals. In general, HHC quality requirements can be identified for both patients (in the form of quality-of-life requirements), and the respective HHC delivered services. However, to realise quality requirements for empowering palliative cancer patients and their carers including family members. This has led to rethinking the appropriateness of using business process modelling as feeding back into goal-oriented modelling without linking to the full policy and developing a holistic i* palliative care strategic models, where all quality requirements (soft goals) elicited along with their soft goal dependencies identified, specified with hierarchical dependencies satisfied and measured top-down and bottom-up. In particular, the SR model needs to be facilitating tracing quality of life requirements satisfaction for critical needs of the palliative care processes in general and the HHC process in particular. Examples of such HHC quality (i.e., i* SR soft goals) requirements are

1. The availability of professions that are best suited as patient-focused and proactive;
2. The completeness and consistency of HHC procedures;
3. The timely availability of information to enable most efficient and patient satisficing palliative decision making in permitting HHC actors effectively carrying out their HHC assigned responsibilities.

Finally, the dependency strengths of dependums have not been modelled, which is necessary to indicate the extent of vulnerability for a respective dependency. This contributes to informing decision makers the required effort in attempting to deliver a dependum. Failure to address such a critical dependency has further viability implications not only on dependee's dependencies but on dependee's dependee's dependencies in HHC.

(2) Linking the i* framework of Palliative Homecare to UNSDGs goals through UNSDG3 to the i* framework

Analysis of the associations between the i* SD model actors and UNSDG3 KPIs, *UHC* principles, and UN barriers to palliative care in the cancer care context revealed a number of significant findings. ***First,*** a number of grouped associations between UNSDG3 KPIs and (UHC principles and barriers to palliative care) have been identified and linked to associated actors, as can be gleaned from Table 3, for example, the category of [(UNSDG3.8.1), (UHC.P1, UHC.P2), (PC.B1, PC.B2, and PC.B3), Patient Care CNC, and PC Consultant)]. ***Second,*** it is now possible to identify which UHC principle is impacted by any palliative care barrier and which actors, goals, tasks, and resources are required. This, in return can inform the healthcare policy and decision makers to revisit their policies, plans, budgets, and constraints for the deficiencies in the qualitative satisfaction of the UHC principals. It also can also inform those stakeholders how PCB can be alleviated in association with the actors in the i* SD and then linked to the i* SR for further elaboration on goals, tasks, and resources. ***Third,*** any actor instance (of the role type "actor") can be investigated for any particular hinderance of the satisfaction of UHC principles, and ultimately, the UNSDG3 implied KPIs. ***Fourth,*** once this linkage approach is fully automated, it is possible to conduct change impact analysis if actors, goals, tasks, and resources are to be changed to reveal the impact they may have on other universal health cover and barriers in the full forward and backward traceability network from the UNSDG3 to the SD model.

Table 3. Categories of linked unsdg 3, who uhc principles, and who palliative care barriers to i* sd actors of palliative homecare in a cancer care organization.

UNSDG KPI	Dependency on UHC Principle	Affected UN Palliative Care Barrier	Actors in i* SD Model	Affected Actor in the i* SD Model
UNSDG3.8.1	*UHC.P1* *UHC.P2*	*PC.B1* *PC.B5* *PC.B6*	*Patient Care CNC*	*PC Consultant*
UNSDG3.8.1	*UHC.P2* *UHC.P3*	*PC.B1* *PC.B2* *PC.B4* *PC.B5* *PC.B6*	*Patient Care CNC*	*Home Healthcare Nurse*
UNSDG3.8.1	*UHC.P2* *UHC.P3*	*PC.B1* *PC.B2* *PC.B4*	*Home Healthcare Nurse*	*HHC Specialist*
UNSDG3.8.1	*UHC.P2* *UHC.P3*	*PC.B1* *PC.B2* *PC.B4*	*Home Healthcare Nurse*	*HHC Specialist*
UNSDG3.8.1	*UHC.P1* *UHC.P2* *UHC.P3*	*PC.B1* *PC.B2* *PC.B4*	*HHC Specialist*	*Home Healthcare Nurse*
UNSDG3.8.1 *UNSDG3.8.2*	*UHC.P1* *UHC.P2*	*PC.B1* *PC.B2* *PC.B3* *PC.B4* *PC.B8*	*Home Healthcare Nurse*	*Pharmacist*
UNSDG3.8.1	*UHC.P1* *UHC.P2* *UHC.P3*	*PC.B1* *PC.B2* *PC.B4*	*HHC Specialist*	*HHC Consultant*
UNSDG3.8.1	*UHC.P1* *UHC.P2*	*PC.B1* *PC.B2* *PC.B4*	*HHC Specialist*	*Social Worker*

6. Conclusions

This research has addressed the current research gap in linking the UHC principles to UNSDGs and in particular UNSDG 3 and the WHO identified PCB using the i* framework SD and SR models applied to HHC of a regional cancer care organisation. An integrated framework has been developed that not only links UHC principles and WHO barriers of palliative care to UNSDG 3, but also provides a full dependency network that facilitates observing the linkages and the impact of the most critical and strategic actors in HHC (along with respective goals, tasks and resources) on the UHC, barriers to palliative care and UNSDG 3 KPIs. Such linkages are anticipated to reinforce directives of healthcare policy and decision makers to undertake change-impact analysis to improve adherence to the Universal Health Care Coverage and the WHO palliative care principles linked with the i* framework SD and SR models. In addition, this work has inspired further work in progress in developing data analytics platform driven by data- and goal- oriented process improvement of universal health coverage.

Furthermore, this research has made a first attempt to develop an i* framework visual goal-oriented and social requirements models of the hospital home care process of the domain of palliative care applied to a case study from a leading regional cancer centre in the Middle East, namely KHCC. This i* framework contributes further to bridging the gap between the world of palliative care process requirements and their reflective computer-based information systems and IoT smart devices [1]. Hence, this sheds the direction attempted by the current researchers towards the realisation of the field of palliative care - as being systems of systems with the respective sociotechnical systems involvement - for the best care of the palliative patient and especially terminal cancer patients.

Finally, the development of the UHC-PCB-UNSDG-i* network (and associated framework) paves the way to investigate the generalisation of this approach when applied to the wider coverage of the full 17 2030 United Nations Sustainability Development Goals (UNSDS).

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Yousra Odeh holds a PhD in Software Engineering from the University of the West of England, UK. She has spent 8 years working in the health care industry case studies. She had her Computer Science BSc from University of Jordan, Jordan. Yousra holds an Innovation Associate credential from Global Innovation Management Institute (GIMI). Yousra is particularly interested in the goal and quality -oriented requirements engineering of software systems, ontology development, business process modelling and architecture that can improve patient care and outcomes. Her research has focused on developing innovative approaches to requirements engineering that can help software development community better understand the needs of patients, clinicians, and other stakeholders. In addition to her academic work, Yousra has also worked as a consultant and business analyst in software development organizations. Her expertise in software requirements engineering has helped these organizations to develop more effective and efficient software systems that can improve outcomes.

Dina Tbaishat, PhD, UK graduate - After 7 years teaching at University of Jordan, Dina is currently teaching at Zayed University - College of Technological Innovation. Active and founding member of the iOntoBioethics Research Group, and the 1st international conference "Women in Academia". Amongst the teaching of the 1st MSc in Cancer Care Informatics taught and research programme run by King Hussein Cancer Center (KHCC) and the University of Jordan, with input from University of the West of England, Bristol, UK. Following research in business process modelling Dina has been active researcher in digital health with research and development in Cancer Care Informatics. Recent work investigated the use of machine learning for generating ontological bioethics topics, medical diagnosis and feature selection. During the past two years' experience at Zayed University, Dina obtained two grants as principal investigator; the Start-Up fund and the Research Incentive Fund, leading projects of medical diagnosis and fraud detection in medical claims using deep learning techniques, respectively.

Faten F. Kharbat, PhD, Associate Professor of Artificial Intelligence, computer Science at Al Ain University, UAE. Founding member of the iOntoBioethics Research Group, and the 1st International Conference on Cancer Care Informatics in 2018. She has spent over 10 years working in cancer health informatics. Associate Professor in the 1st MSc in Cancer Care Informatics taught, and research programme jointly run by KHCC and the University of Jordan, with input from the University of West of England, Bristol, UK. Chairs various Scopus conferencing, ACIT 2019, ACIT 2022, and SNAMS-2023. Currently working on different projects including the iCanViz, Special needs' Assessment guided by AI, and FinTech. Her research interests include Cancer Informatics, Image Processing, Data Mining tools & techniques, and technology in education.

Omar Shamieh, MD is American Board Certified in Internal Medicine, Geriatric Medicine, Hospice & Palliative Medicine. He also obtained his MBA from the Keller Graduate School of Management, DeVry University, USA. Chairs the Palliative Care, Pain Management and Psychosocial Oncology Chair at King Hussein Cancer Center - KHCC in Jordan with more than 18 years of experience in palliative & Supportive Oncology. Serves as the Chairman of Jordanian National Palliative Care Committee and leads the Jordanian National Home Care Initiative to improve community and home care in Jordan. Founder and leader of the Center for Palliative & Cancer Care in Conflict, CPCCC at KHCC, since 2018. Active researcher in cancer, palliative care, pain and symptom management, clinical reported outcomes, supportive care, quality of life and psychosocial oncology involving patients living in Areas of conflict for more than 10 years. Has significant regional and international contribution to palliative clinical care, education, training, advocacy, and research. Served as the Jordan government's scientific adviser and WHO advisor on palliative care from 2006-until now. Member of a range of research funding and policy committees such as R4HC - MENA, USAID, and EORTC (Quality of life group), Ministry of Health, Jordan Medical Council and High Health Council. Led the 2018 first national palliative care strategy in Jordan; conducted the first study on palliative and home care economic evaluation in Jordan; has interests in research translation and knowledge exchange combined with conducting empirical research and building strong academic teams with a wide range of regional roles.

Mohammed Odeh, PhD, Professor of Cancer Care Informatics, King Hussain Cancer Center (KHCC), Jordan and University of the West of England, Bristol, UK with research & development in Cancer Care Informatics since 2002. First globally awardee of the "Professorial" title in Cancer Care Informatics in 2018. Co-founded with KHCC the Cancer Care Informatics initiative and discipline in 2016 aligned with international off-springs including the 1st International Conference on Cancer Care Informatics in 2018, the 1st MSc in Cancer Care Informatics taught, and research programme jointly run by KHCC and the University of Jordan, with input from the University of West of England, Bristol, UK. Has been UWE Bristol co-investigator on EU FP5, FP6 and FP7 projects and led research bid submissions on Horizon 2020 and Erasmus+ funding programmes. Has been research grants reviewer scientist for the UK EPSRC and the European Science Foundation (ESF). Successfully research-led and supervised more than 20 PhD successful completions with graduates in impactful graduate destinations. Has in-excess of 120 research articles and on international higher education panels for reviewing research and taught programmes in international universities. Founded and led the Software Engineering Research Group of UWE Bristol in 2005-2020. Holds one US formally endorsed patent (OntoREM, as the UWE Bristol principal investigator) with Dr. Kossmann, Airbus and another recently filed Jordanian patent application (PArch.BB&T) in Blood Banking and Transfusion, which he has been the director of. Chairs the special topic issue, with three leading guest topic editors, of the leading and impactful Frontiers Information Medicine in "process-based and informatics-enabled regulatory healthcare". Has been on the referees' panel of distinguished international prize committees such as the prestigious AbdulHameed Shoman Prize for distinguished Arab Researchers. Founder and CEO of the Global Academy for Digital Health (GA4DH). Chairs the special topic issue, with three leading guest topic editors, of the leading and impactful Frontiers Information Medicine in "process-based and informatics-enabled regulatory healthcare".