

Conference Paper

The Application of Levine's Conservation Model on Nursing Care of Children with Cancer Experiencing Chemotherapy-Induced Mucositis in Indonesia

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Abstract

Background: Mucositis is a common side effect in children with cancer experienced chemotherapy. Levine's Conservation Theory views children as open individuals who always respond to the environment. Children with cancer undergoing chemotherapy are seen as individuals who adapt to threats from the internal-external environment. The threat from the internal environment is the presence of cancer cells that threaten normal cells, while the external environment is the side effects of chemotherapy and environmental exposure. The nurse is responsible for carrying out a series of nursing processes to prevent the occurrence of mucositis due to chemotherapy. **Objectives:** This study aimed to explore the nursing process that was given to children experiencing chemotherapy-induced mucositis using Levine's Conservation Theory. **Methods:** This study was conducted with a case study. Ten children with cancer who experienced chemotherapy due to mucositis was participated in this study. Nursing process was applying by Levine Conservation Theory for one month at National Referral Hospital in Jakarta. Case studies are carried out by applying the nursing process according to Levine's Conservation Theory, which consists of trophicognosis, hypothesis, nursing intervention and evaluation. Data analysis within cases and across cases is conducted by content analysis related to Levine's evaluation model. **Results:** The results of the case study show that eight clients experienced energy conservation imbalances, ten clients experienced structural integrity disorders and eight clients experienced impaired social integrity. The results of the application of the Levine Conservation Theory for one month showed only two clients who could not achieved energy conservation and structural integrity. **Conclusion/Importance:** This case study shows that the Levine conservation model can be used in the nursing process in children with mucositis to maintain energy conservation and structural integrity. Nurses are expected to understand the application of Levine's conservation theory to clients who are prone to conservation problems.

Keywords: children, cancer, case study, mucositis, levine's conservation model.

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Received: 22 September 2019

Accepted: 4 October 2019

Published: 10 October 2019

Publishing services provided by
Knowledge E

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Selection and Peer-review under the responsibility of the ICHT 2019 Conference Committee.

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1. Introduction

Chemotherapy is effective for treating cancer in children (Hockenberry & Wilson, 2016). Besides having therapeutic effects that inhibit the growth of cancer cells, chemotherapy also has dangerous side effects and requires intensive treatment to manage it. Mucositis is common side effect of chemotherapy among children (Hockenberry & Wilson, 2016). Mucositis is inflammation and ulceration of the oral mucous membrane. Oral mucosa consists of mucosal cells that continue to divide rapidly. Interference in mucosal cell division due to chemotherapy will trigger mucositis (Ribeiro, Limeira, de Castro, et al. 2017).

According to Ribeiro, Limeira, de Castro, et al. (2017) and United Kingdom Children's Cancer Study Group and the Pediatric Oncology Nurses Forum or UKCCSG-PONF (2014), the prevalence of mucositis due to chemotherapy was estimated at 30-75%. Thomaz, Mouchrek, Silva, et al. (2013) and Cheng, Goggins, Thompson, et al (2008) reported that the prevalence of mucositis is even greater, which is around 45-80%. Mucositis due to chemotherapy can be very severe. According to Eilers and Million (2011), mucositis causes a variety of disorders, including physiological disorders and functional disorders. Physiological disorders include lesions, ulceration, excessive inflammation, pain and infection. Lesions and ulcerations due to mucositis can predispose to bacterial, fungal and viral infections. This threatens the child's life because it can become a systemic infection. While functional disorders due to mucositis are difficulty chewing, swallowing and talking.

Nurses as health professionals are responsible for providing quality nursing services to treat mucositis due to chemotherapy. According to the International Council of Nurses or ICN (2009) child nurses play a role to provide professional practice that is responsible and accountable in ethical and legal aspects (professional, ethical, legal practice), providing care and management of nursing care (care provision and management) to children and families and develop professionalism in order to improve the quality of nursing services and nursing care (professional, personal and quality development). This role can be realized by providing quality nursing care to children and families. Nursing care is carried out with the aim of children and families to achieve optimal health degrees, assist the healing process of children and/or die peacefully (Hockenberry & Wilson, 2016).

One theory of nursing models that can be applied in treating children with cancer is the Levine's Conservation Model that describes a complex way that allows individuals (children) to continue functioning even though faced with very severe challenges/obstacles (Alligood, 2017; Mefford & Alligood, 2017). The conservation model according to Levine focuses on adaptation so that individuals can maintain the integrity of the individual using the principle of conservation. Nurses are expected to play a role in increasing individual adaptation through interventions carried out with the principles of energy conservation, conservation of structural integrity, conservation of personal integrity and conservation of social integrity.

Levine views children as open individuals who always respond to the environment (Alligood, 2017). Children with cancer are seen as individuals who adapt to threats from the internal and external environment (Eilers & Million, 2011; Mefford & Alligood, 2011). The threat from the internal environment is the presence of cancer cells that threaten normal cells, while the threat from the external environment is in the form of side effects of modality therapy (chemotherapy, radiotherapy or surgery) as well as various physical and psychological stressors (Eilers & Million, 2011; Alligood, 2017). According to Levine, nurses can help the child adaptation process by conducting a series of nursing processes: assessment, trophocognosis (nursing diagnosis), hypothesis (plan for nursing interventions), nursing interventions (therapeutic intention) and nursing evaluation. If the nurse succeeds in helping the child to adapt, then the child is expected to be able to maintain all of the conservation modes to achieve wholeness.

Leach (2006) and Alligood (2017) stated that nurses play a role as a conservator who facilitates and helps the conservation of structural integrity for children who experience impaired structural integrity including mucositis. The purpose of this case study is to identify the application of the Levine conservation model in the nursing process in children with cancer suffering from mucositis due to chemotherapy.

2. Methods

2.1. Study design

This study was conducted with a case study. Nursing process was applying by Levine's Conservation Model as delivery care modes for a children with mucositis. Case studies are carried out by applying the nursing process according to Levine's Conservation Model, which consists of trophocognosis, hypothesis, nursing intervention and evaluation. Levine's Conservation Model, used as the nursing guideline, successfully

identified patient issues including failure to conserve energy, structural, personal and social integrity. Interventions included: (1) oral care bundles and early goal directed therapy to reduce patient energy expenditure; (2) prevention of infection to maintain structural function; and (3) enhancement of self-esteem, privacy, family cohesion, and social activities to maintaining personal and social integrity functions. The interventions helped the case adapt successfully to the structural-integrity disturbance that caused by mucositis. This case report provides a valuable nursing care experience as a reference for similar mucositis cases in the future.

2.2. Sample

Ten clients of children with cancer who experienced chemotherapy due to mucositis was participated in this study. The inclusion criteria in this study were children who suffer from cancer and were being hospitalized and undergoing chemotherapy.

2.3. Data collection procedure

Data were collected using physical assessment, medical chart reviews, interviews patient family members, and observing the patient during hospitalization at National Referral Hospital in Jakarta, Indonesia. The interventions and activities flow from this case study is depicted in scheme 1. The first step began with a nursing assessment which included a physical examination including examination of mucositis stage, review of medical supporting data, interviews with patients and families to determine problems and needs of patients and families. After that, the nurse then conducted the second phase of determining the diagnosis (trophicognosis). In this phase the nurse determines the nursing diagnosis based on the patient's problem and made a priority scale. The next step is the hypothesis stage. At this stage the nurse determines the objectives and criteria for the results to be achieved. Then, nurses carry out interventions that aim to improve the process of adaptation to achieve individual wholeness. The interventions included giving: (1) oral care bundles and early goal directed therapy to reduce patient energy expenditure; (2) prevention of infection to maintain structural functions; and (3) enhancement of self-esteem, privacy, family cohesion, and social activities to maintain personal and social integrity functions. The final step is evaluation, in this step nurses evaluate each patient based on the outcomes that was settled in hypothesis step. Data was analyzed based on content analysis using Levine's evaluation nursing process.

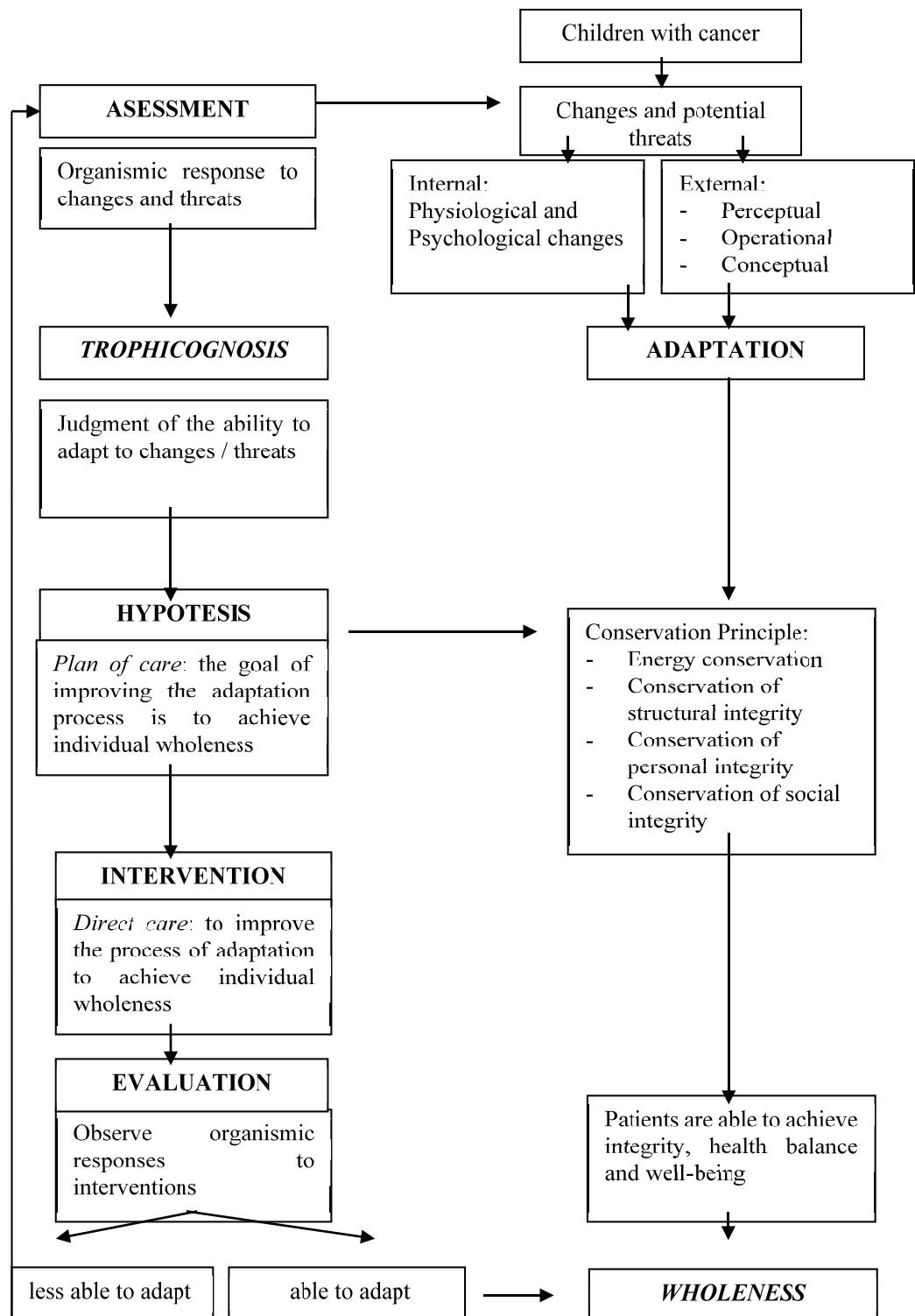


Figure 1: Integration of the Levine Conservation Model in the Nursing Process in Children with Cancer.

3. Results

The following table will explain the characteristics of respondents.

TABLE 1: The Characteristics of respondents.

Characteristics	Mean±SD	Min-Max
Mean age (years)	6.5±0,8	Minimum: 14 Maximum: 1
Year living with cancer (year)	1.3±0,2	Minimum: 1 Maximum: 3
	f	%
Type of cancer:		
Leukemia	6	60
Lymphoma	3	30
Retinoblastoma	1	10
Type of mucositis:		
Mild to moderate	2	20
Severe	8	80
Type of mucosatoxic agent:		
Mild to moderate	1	10
High	9	90

Table 1 shows that the mean age of respondents was 6.5±0,8years with mean year living with cancer was 1.3±0,2 years. Most of the patients had leukemia, 80% had severe mucositis, and 90% received chemotherapy with high mucosatoxic types.

Based on the results of the assessment using Levine’s conservation model, the following table presents nursing problems according to the conservation principle.

TABLE 2: Nursing Problem based on Levine’s Conservation Model.

Levine’s Conservation Model	Hypothesis of Nursing Problem
Energy Conservation	Hyperthermia, Ineffective breath pattern, Nutritional imbalance, Fatigue Lack of fluids and electrolytes
Structural Integrity Conservation	Pain, Impaired of oral mucosal integrity Risk of injury Impaired of anal mucosa integrity Difficult to swallow
Personal Integrity Conservation	Low self-esteem related to impaired body image Anxiety Despair Fear related to diagnostic procedures Risk for growth and developmental disorders
Social Integrity Conservation	Impaired social interactions, Disruption of family processes Anticipation of grieving Family anxiety

Table 1 explains some of the nursing problems identified in all respondents in the four conservation domains. In the energy conservation domain, nursing problems that

have been experienced by patients were hyperthermia, ineffective breath pattern, nutritional imbalance and fatigue. Whereas nursing problems related to structural integrity were pain, impaired of oral mucosal integrity, risk of injury, impaired of anal mucosa integrity and difficult to swallow. Then the nursing problem the area of personal integrity was low self-esteem related to impaired body image, anxiety, despair, fear related to diagnostic procedures, risk for growth and developmental disorders. Lastly, nursing problems related to social integrity were impaired social interactions, disruption of family processes, anticipation of grieving and family anxiety.

After formulated nursing diagnosis, then nursing intervention bundles delivered to patient. The intervention bundles included: (1) oral care bundles and early goal directed therapy to reduce patient energy expenditure; (2) prevention of infection to maintain structural function; and (3) enhancement of self-esteem, privacy, family cohesion, and social activities to maintaining personal and social integrity functions. After one month intervention using Levine’s conservation model, the evaluation of care showed that the interventions helped patients to adapt successfully especially to the structural-integrity problem related to mucositis. Table 3 presents the results of the initial assessment and final evaluation of patients after one month of nursing intervention based on the levine’s conservation model.

TABLE 3: The initial assessment and final evaluation after one month nursing intervention based on Levine’s Conservation Model.

Before Intervention	F (%)	After Intervention	F(%)
Patients experienced energy conservation problems	8 (80)	Patients experienced energy conservation problems	2(20)
Patient experienced structural integrity conservation problems	10 (100)	Patient experienced structural integrity conservation problems	2(20)
Patients experienced personal integrity conservation problems	3 (30)	Patients experienced personal integrity conservation problems	2(20)
Patients experienced social integrity conservation problem	3 (30)	Patients experienced social integrity conservation problem	3(30)

The results of this case study showed that before intervention 8 clients experienced energy conservation problems, 10 clients experienced structural integrity problems, 3 clients experienced personal and social integrity problems. After one month intervention using Levine’s conservation model, there has been a better change in the patient’s condition, this has been proven with only 2 people experiencing problems related to energy conservation and structural integrity. Meanwhile, patients who experienced problems related to personal integrity also declined, from 3 to 2 patients. On the other hand, there has been no change in patients who experience problems related to social integrity.

4. Discussion

Levine's conservation model is one of the nursing models that can be applied in child nursing care. The conservation model focuses on adaptation and maintaining individual wholeness using the principle of conservation. This model will provide an overview for nurses to look at individuals as a whole and see individual responses according to organismic level starting from the fight, flight response, inflammatory response, stress and perceptual response. Alligood (2017) explains that the Levine conservation model is based on three main concepts, namely adaptation, wholeness and conservation. Adaptation is a process of change, as a result of adaptation, conservation will be created. Adaptation is a process that shows the ability of individuals to maintain integrity in certain environmental realities (Levine, 1989 in Tomey & Alligood, 2017). Nurses are expected to play a role in increasing individual welfare through interventions conducted with the aim of energy conservation, conservation of structural integrity, conservation of personal integrity and conservation of social integrity.

The characteristics of adaptation are: 1) Historicity means that adaptation is a historical process, where the response is based on past experience both in personal and genetic terms; 2) Specificity, that adaptation is also specific, meaning that the individual behavior has a specific and unique stimulus response pattern in daily life activities; and 3) Redundancy, which means that choices will survive or fail by individuals to ensure sustainable adaptation. If a body system is unable to adapt, then another system will take over and complete its work. Redundancy is influenced by trauma, age, illness or environmental conditions that make it difficult for the individual to survive (Parker, 2005). Adaptation ability will lead individuals to achieve conservation, and the main goal of conservation is achieving individual wholeness (Leach, 2006).

The main goal of conservation is to maintain and maintain the integrity of the system according to their respective functions and achieve a balance (equilibrium) through the provision of nursing interventions so that individuals can achieve wholeness (Levine, 1973, in Leach, 2006). Conservation is considered as a process of maintaining a state of homeostasis to maintain the stability of an organism, through a synchronization of interactions between individuals and the environment, especially in a challenging situation (Leach, 2006). Levine described that conservation includes four (4) main principles, namely energy conservation, conservation of structural integrity, conservation of personal integrity and conservation of social integrity.

Energy conservation is defined as an effort to strike a balance between energy supply and demand in the unique reality of the individual (Alligood, 2017). The nurse's

role is to help the client achieve energy balance by undertaking nursing activities that focus on maintaining nutritional balance, including those which threaten conditions that can lead to an increase in energy needs or in circumstances where there is an increase in energy expenditure. Energy conservation is achieved by maintaining a balance between nutrient intake (micronutrients, macronutrients, fluids and oxygen) and energy expenditure to avoid fatigue. The energy balance is useful so that the body can maintain the body's patterns and functions. Energy balance is the basis of all individual functions. A good energy balance will also lead individuals to achieve conservation of structural integrity, personal integrity and social integrity.

The second principle of conservation is the conservation of structural integrity. Levine considers that changes in structural integrity can affect human function. Conservation of structural integrity is maintained by intervening to maintain and restore body structure by preventing physical damage and enhancing the healing process (Leach, 2006). In further principles, Levine also views that one of the basic goals of the nursing process is to help the individual to maintain his personal integrity. Levine assumes that individuals need privacy, rights and responsibilities to determine their own decisions, maintain self-identity and self-respect (Leach, 2006). Nursing interventions are carried out to achieve personal integrity by protecting and respecting client privacy, desires, client coping mechanisms and supporting client's personal choices. The principle of personal integrity is interdependent with the principles of energy conservation and structural integrity. Without adequate energy and good structural integrity, it is difficult for individuals to maintain personal integrity (Leach, 2006).

The third principle of conservation is the conservation of social integrity. Conservation of social integrity is based on the premise that an individual's life will be valuable if the individual is able to interact with the social environment. Levine also views that individual behavior is influenced by the ability to carry out social interactions (Leach, 2006). Leach (2006) further explained that the state of the individual would definitely affect the surrounding social conditions. Children who are sick and need care in general will affect family conditions. Sick condition may also threaten the ability of clients to interact with others. The ability of an individual's social integrity is influenced by factors such as family, friends, culture, religion, education, socioeconomic status and other factors (Leach, 2006). Nursing interventions aim to maintain the ability of individual social integrity by providing support and education to families, increasing family participation in care, and facilitating clients to interact with others (Leach, 2006).

Levine views children as open individuals who always respond to the environment. Levine emphasized that the Levine Conservation Model was developed with the aim that

nurses can use scientific and creative thinking skills in providing nursing care to clients (Alligood, 2017). Levine's treatment theory is basically the same as the elements in the treatment process in general. In the Levine model, the client is seen in an interdependent position, the client needs help from nurses to adapt to health problems. The nurse is responsible for determining the amount of client participation ability in care. This case study was conducted by applying the nursing process according to the Levine Conservation Model consisting of the following phases: assessment, trophycognosis, hypothesis, intervention and evaluation.

In this case study, the assessment is carried out by considering conservation principles that include energy conservation, by assessing the balance of energy supply with energy needs; conservation of structural integrity, by assessing structural integrity and defense capabilities of the client's body, conservation of personal integrity, by examining the client's uniqueness, values, client's ability to maintain a sense of worth (self-worth), client's coping mechanism and client's ability to perform self-actualization; and conservation of social integrity regarding the ability of clients to participate in social systems (Alligood, 2017). This phase followed by trophycognosis. In this phase, nurses analyze the results of the assessment and determine the nursing problems that arise by considering the four principles of conservation.

Based on the results of the study it can be concluded that the client is unable to maintain energy conservation because there is a tendency of imbalance between supply and energy needs, due to increased respiratory work, anorexia and decreased tolerance of oral intake. Clients also experience fatigue due to increased respiratory work and metabolic needs. Some Trophycognosis that can be formulated are as follows: 1) The ineffectiveness of breath pattern is related to the ineffectiveness of pulmonary compliance and recoil due to the continued process of inflammation in the lungs characterized by clients complaining of tightness, respiratory frequency 42 x / minute, there is intercostal retraction; 2) Fever is associated with an increase in the hypothalamus set point due to the continued course of cancer (paraneoplastic fever), neutropenia and pancytopenia; 3) Nutritional imbalances: less than the need related to anorexia, increased respiratory work and disease processes; 4) Fatigue is associated with increased respiratory work and metabolic needs.

In the structural integrity conservation, results of the study showed that client is unable to maintain the integrity of the body's defenses due to the occurrence of mucositis, the occurrence of hemoptysis due to disruption of blood cell formation which results in the defense system and the homeostasis system. Enforced trophycognosis is designed to help clients with independent nursing intervention and collaboration so that the body

can function properly. Based on clinical manifestations and complaints shown to the client, trophycognosis can be formulated as follows: 1) The ineffectiveness of the airway clearance is related to the accumulation of secretions due to the continued inflammatory process which is characterized by the client coughing up phlegm, sometimes phlegm mixed with blood; 2) Pain associated with activation of free nerve ending due to continued mucositis which is characterized by the client complaining of pain in the mouth due to canker sores, pain scale 8, the client refuses to drink or eat orally; 3) Impaired skin integrity: oral mucosa is associated with decreased immunological defenses and side effects of chemotherapy, which is characterized by a scale of OAG 16 mucositis (moderate mucositis); 4) Bleeding is associated with suppression / suppression of hematopoiesis-forming cells due to the continued course of the disease and side effects of treatment, characterized by platelet levels of 46,000 / ul; and 5) High risk of infection is related to a decrease in the immune system due to further leucopenia and neutropenia.

In the personal integrity conservation, the problems that experienced by patients were associated with changes in health status, limitations experienced due to the disease process and body image disturbances due to side effects of treatment. Trophycognosis that can be formulated in this area were: 1) Anxiety associated with the course of the disease, treatment procedures and side effects of treatment, characterized by expressions of anxiety clients fear not being able to go to school anymore and often ask how long the completion of the treatment underwent; 2) Impaired body image associated with side effects of treatment, which is signed by the client saying shame because his hair is now bald, the client said he did not want to meet with his friends.

The ability to maintain conservation of social integrity is very important in children's lives so that children are able to carry out their developmental tasks properly. Based on the results of the assessment, it was found that the client experienced social integrity problems due to changes in health status and side effects of treatment. Trophycognosis that is enforced on the client were: 1) Disruption of social interaction that associated with body image, marked by parents saying children are embarrassed and do not want to meet neighbors, friends or relatives who come to visit; and 2) The changes in family processes related to crisis situations and lack of knowledge

5. Conclusion

The conservation model according to Levine can be applied in providing nursing care to children with cancer. The Levine conservation model provides an overview of the

framework for interventions to support the adaptation process in children with cancer through a series of interventions aimed at increasing the ability to conserve energy, conserve structural integrity, conserve personal integrity and conserve social integrity. It is hoped that preserving the ability of conservation can support the adaptation of children with cancer in achieving wholeness and well-being. In implementing the Levine conservation model, nurses discovered several obstacles related to the operation of the model in the nursing process in children with cancer. The Levine conservation model is a universal model and some of the concepts of the model still require operationalization. Child nurses are expected to develop a more operational Levine conservation model in nursing practice. A qualitative study to explore nurses experience in application of this models is highly needed.

Disclosures

The authors report no real or perceived vested interests that relate to this article that could be construed as a conflict of interest.

Acknowledgements

None. No funding to declare.

Authors' Contributions

I.N.: provided the conception and design of the study, acquisition of data, analysis and interpretation of data, drafting the article, revised it critically for important intellectual content, and final approval of the version to be submitted; T.P: supplied the acquisition of data, drafting of manuscript; N.O.H: supplied the design of study, analysis and interpretation; and A.N.: supplied the acquisition of data and was responsible for the article critically for important intellectual content.

References

- [1] Hockenberry, M.J., & Wilson, D. (2016). Wong's essential of pediatric nursing.(10th edition). Missouri: Mosby Company.
- [2] Ribeiro, I.L.A., Limeira, R.R.T., de Castro, R.D., Bonan, P.R., & Valenca, A.M. (2017). Oral mucositis in pediatric patients in treatment for acute lymphoblastic leukemia.

- Int.J.Environ Res Public Health, 14(12), 1468-1476
- [3] Thomaz E.B., Mouchrek J.C., Silva A.Q., Guerra R.N., Libério S.A., Cruz M.C., Pereira A.L. (2013). Longitudinal assessment of immunological and oral clinical conditions in patients undergoing anticancer treatment for leukemia. *Int. J. Pediatr. Otorhinolaryngol*, 77, 1088–1093. doi: 10.1016/j.ijporl.2013.03.037.
- [4] Cheng K.K., Goggins W.B., Lee V.W., Thompson D.R. (2008). Risk factors for oral mucositis in children undergoing chemotherapy: A matched case-control study. *Oral Oncol*, 44, 1019–1025. doi: 10.1016/j.oraloncology.2008.01.003.
- [5] Eilers, J., & Million, R. (2011). Clinical update: prevention and management of oral mucositis in patients with cancer. *Semin Oncol Nurs*, 27(4), 1-16
- [6] International Council of Nurses. (2009). ICN regulation series: ICN framework of competencies for the nurse specialist. Geneva: ICN
- [7] Alligood, M.R. (2017). *Nursing theorists and their work* (9th edition). Elsevier
- [8] Leach, M.J. (2006). *Wound management: Using Levine's conservation model to guide practice*.
- [9] Alligood, M.R. (2013). *Nursing theory: Utilization and application* (5th edition). Missouri: Mosby.
- [10] Avritscher, E.B., Cooksley, C.D., & Elting, L.S. (2004). Scope and epidemiology of cancer therapy - induced oral and gastrointestinal mucositis. *Seminars in Oncology Nursing*, 39(2), 91-100.
- [11] Baggot, R.B., Kelly, K.P., Fochtman, D., & Folley, G. (2001). *Nursing care of children and adolescent with cancer* (3rd ed.). Pennsylvania: W.B Saunders Company
- [12] Bakker., B., Oostjik, W., Bresters, D., & Walenkamp, M.J. (2004). Disturbances of growth and endocrine after busulfan-based conditioning for hematopoietic stem cell transplantation during infancy and childhood. *Bone Marrow Transplantation*, 33, 1049-1056.
- [13] Ball, J.W., Bindler, R.C. (2003). *Pediatric nursing: Caring for children*. (3rd edition). New Jersey: Pearson Education, Inc.
- [14] Berman, A., & Snyder, S.J. (2012). *Kozier & Erb fundamentals nursing: Concepts, Process and practice*. 9th Edition. New Jersey: Pearson Education Inc.
- [15] Birmingham Children's Hospital, (2007). *Cytotoxic Chemotherapy*. Birmingham: Birmingham Foundation Trust.
- [16] Bowden, V.R., Dickey, S.B., & Greenberg, C.S. (1998). *Children and their families: The continuum of care*. Philadelphia: W.B Saunders Company.

- [17] Buegel, A.L. (2009). Nutrition related disease risk in pediatric cancer survivors. The Ohio State University: Thesis.
- [18] Buffler, P.A., Kwan, M.L., Reynolds, P., & Urayama, K.Y. (2005). Environmental and genetic risk factors for childhood leukemia: Appraising the evidence. *Cancer Investigation*, 1, 60-75.
- [19] Chabner, B.A. (2005). *Cancer Chemotherapy and biotherapy: Principle and practice*, (4th edition). Philadelphia: Lippincott Williams & Wilkins.
- [20] Chemaitilly, W., & Sklar, C.S. (2010). Endocrine complications in long-term survivors of childhood cancers. *Endocrine-Related Cancer*, 17, 141-159.
- [21] Chow, E.,J., Friedman, D.I., Yasui, Y., Whitton, J.A., Stovall, M., Robinson, L.L., & et al. (2007). Decrease adult height in survivors of childhood acute lymphoblastic leukemia: A report from the childhood cancer survivor study. *The Journal of Pediatrics*, 150(4), 270-375.
- [22] Dodd, M.J. (2004). The pathogenesis and characterization of oral mucositis associated with cancer therapy. *Oncology Nursing Forum*, 31(4), 5-12.
- [23] Ekman, I., & Ehrenberg, A. (2002). Fatigue in chronic heart failure: Does gender make a difference?. *European Journal of Cardiovascular Nursing*, 1, 77-82.
- [24] Elhasid, R., Laor, A., Lischinsky, S., Postovsky, S., & Arush, M.W. (1999). Nutritional status of children with solid tumors. *American Cancer Society*, 16, 110-124.
- [25] Friese, C.S. (2006). Chemotherapy-induced neutropenia: Important new data to guide nursing assessment and management. *Cancer Therapy and Supportive Care*, 21-25.
- [26] Gralla, R.J., Houlihan, N.G., & Messner, C. (2010). *Understanding and managing chemotherapy side effect*. New York: Cancer Care Connect.
- [27] International Myeloma Foundation. (2007). *Understanding dexamethasone and other steroid*.
- [28] Intercultural Cancer Council. (2007). *Cancer facts: Leukemia, lymphoma, myeloma & myelodysplastic syndrome: Population at risk*.
- [29] Kaplow, R. (2001). Special nursing consideration. *Critical Care Clinique*, 17, 769-789.
- [30] Meleis, A.I. (2007). *Theoretical nursing development & progress*. (4th edition). Lippincott: Williams & Wilkins.
- [31] Miller, T.L., Lipstiz, S.L., & Mitnik, G.L.(2010). Cancer epidemiology, biomarker and prevention. *Cancer Epidemiol Biomarker*, 19, 2013-2022.

- [32] Mock, V., Ours, C.S., Hall, S., Bositis, A., Tillery, M., Belcher, A., & et al. (2007). Using a conceptual model in nursing research: Mitigating fatigue in cancer patients. *Journal Advance Nursing*, 58(5), 503-512.
- [33] Muehlbauer, P., Thorpe, D., Davis, A., & Rawling, B.L. (2009). Putting evidence into practice: Evidence based intervention to prevent, manage, and treat chemotherapy and radiotherapy induced diarrhea. *Clinical Journal of Oncology Nursing*, 13(3), 336-341.
- [34] NHS Foundation Trust. (2007). Evidence based mouthcare policy. London: Doncaster and Bassetlaw Hospital Release.
- [35] Ophardt, C.E. (2003). Overview of metabolism. Illinois: Elmhurst College.
- [36] Polit, D.F., & Beck, C.T. (2008). *Nursing research: Generating and assessing evidence for nursing practice (8th ed.)*. Philadelphia: Lippincott Williams & Wilkins.
- [37] Polit, D.F., & Hungler, B.P. (1999). *Nursing research: Principle and method*. Philadelphia: Lippincott Williams & Wilkins.
- [38] Potter, A.G., & Perry, P.A. (2008). *Clinical companion for fundamental of nursing (6th ed.)*. St. Louise: Mosby Compan
- [39] Potting, C.M.J., Blijleven, N.A.M., Donnelly, J.P., Feuth, T., & Van Achterberg, T. (2005). A scoring system for the assessment of oral mucositis in daily nursing practice. *European Journal of Cancer Care*, 15(1), 228-234.
- [40] Royal College of Nursing. (2010). Nutrition in children and young people with cancer.
- [41] Sonis, S.T., Elting, L.S., Keefe, D., Schubert, M., Peterson, D.E., Hauer-Jensen, M., et al. (2004). Perspective on cancer therapy-induced mucosal injury: Pathogenesis, measurement, epidemiology and consequences for patients. *Supplement to Cancer American Cancer Society*, 100(9), 95-120.
- [42] Tipton, J., McDaniel, R., Barbour, L., Jhonston, M., Kayne, M., LeRoy, P., & Ripple, M.L. (2007). Putting evidence into practice: Evidence-based interventions to prevent, manage and treat chemotherapy-induced nausea and vomiting. *Clinical Journal of Oncology Nursing*, 11(1), 69-78.
- [43] Tomlison, D., & Kline, N.E. (2010). *Pediatric oncology nursing*. Berlin: Springer.