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Nutrition Care Process Implementation in a Type 2 Diabetes Mellitus Patient with Comorbidities: A Case Study

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ABSTRACT

Type 2 Diabetes Mellitus (T2DM) is a chronic disease frequently accompanied by complications such as chronic kidney disease (CKD) and heart failure, which worsen the patient's clinical condition. Proper nutritional management using a standardized approach is essential to optimize outcomes in patients with complex comorbidities. This study aimed to analyze the implementation of clinical nutrition care using the Nutrition Care Process (NCP) approach in a patient with T2DM and multiple comorbidities. A single-patient case study design was selected because it allows for an in-depth, individualized examination of NCP implementation in a clinically complex situation that is difficult to capture through group based study design. This study aimed to analyze the implementation of clinical nutrition care using the NCP approach in a patient with T2DM and multiple comorbidities, and to contribute practical, evidence-based documentation of NCP application in the Indonesian clinical setting. Data were collected through interviews, 24-hour food recall, and medical record analysis using the Standardized Nutrition Care Process guideline. Nutritional intervention was provided based on the patient's clinical condition, followed by monitoring and evaluation for three days, including dietary intake, biochemical parameters, and clinical conditions. The patient presented with complex clinical conditions, including T2DM, CKD, heart failure, hyperkalemia, and infections. After nutritional intervention, energy intake improved from a moderate deficit (75%) to an average of 94% of requirements. Macronutrient intake met the recommended targets (protein 104%, fat 94%, carbohydrate 97%). Within a three-day observation period, energy intake improved from a moderate deficit (75%) to an average of 94% of requirements. Clinical parameters such as blood pressure also decreased from 173/82 mmHg to 132/61 mmHg. The Implementation of clinical nutrition care using the NCP approach in patients with T2DM and multiple comorbidities can improve nutritional intake, biochemical parameters, and clinical conditions progressively. These findings highlight the practical value of a structured NCP framework for dietitians managing patients with overlapping comorbidities, where individualized and prioritized intervention is essential.

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Introduction

Diabetes Mellitus (DM) is a disease characterized by hyperglycemia or elevated blood glucose levels cause by impaired insulin secretion (Restyana et al., 2015). According to the American Diabetes Association (2024), diabetes mellitus may lead to various chronic complications affecting the kidneys, blood vessels, and nerves. The most common type of diabetes is Type 2 Diabetes Mellitus (T2DM), which has several risk factors, including central obesity, dietary patterns high in fat and simple sugar, lack of physical activity, family history of diabetes, increasing age, as well as hypertension and dyslipidemia (Perkeni et al., 2024). The prevalence of DM continues to increase globally, with complications such as cardiovascular disease, nephropathy, and diabetic foot ulcers becoming major health burdens (Haryana et al., 2022). In Indonesia, the prevalence of DM has reached 10,7% among adults and is expected to increase further along with lifestyle changes (Ismail, L et al., 2021). The management of Diabetes Mellitus becomes more challenging when accompanied by multiple comorbidities that interact with one another.

Chronic Kidney Disease (CKD) is a common complication of DM, occurring in approximately 20–40% of patients with Type 2 Diabetes Mellitus. CKD is characterized by a decline in glomerular filtration rate and structural kidney damage (Izzedine et al., 2021). Diabetic nephropathy develops as a result of chronic hyperglycemia, which causes renal vascular damage and is further aggravated by hypertension and dyslipidemia (Sagita et al., 2021). Patients with DM accompanied by CKD require dietary modifications, including restrictions on protein intake (0.8 g/kg body weight/day), potassium, phosphorus, and sodium in order to prevent the progression of kidney disease (Johnson et al., 2018).

Heart failure (HF) is another condition frequently comorbid with T2DM and CKD, forming a complex clinical trial that significantly complicates patient management. The coexistence of TM2, CKD, and heart failure is associated with worsened prognosis, increased hospitalization rates, and higher mortality risk (Chrysohoou et al., 2022). From a nutritional standpoint, patients with heart failure require careful management of sodium and fluid intake to prevent fluid overload and further cardiac burden, while simultaneously maintaining adequate energy intake to avoid malnutrition (Chrysohoou et al., 2022). The complexity increases when CKD and heart failure coexist, as dietary restrictions for one condition may conflict with the nutritional needs of the other. For instance, potassium rich foods that support cardiac health may be restricted in CKD patients prone to hyperkalemia (Ramos et al., 2021). Therefore, an individualized, systematic nutritional approach is essential in managing patients with such overlapping comorbidities.

The nutrition care process (NCP) is a systematic approach in dietetic management consisting of nutritional assessment, nutrition diagnosis, intervention, monitoring, and evaluation. The implementation of NCP in patients with DM and multiple comorbidities requires individualized management based on clinical conditions, biochemical parameters, and the patient's dietary intake ability.

The NCP model, introduced by the Academy of Nutrition and Dietetics, provides a standardized language through the International Dietetic and Nutrition Terminology (IDNT) that enables dietitians to systematically document, communicate, and evaluate nutrition care outcomes (Nieto-Martinez et al., 2024). Evidence suggests that NCP implementation improves the quality of nutrition care through a structured and standardized approach, allowing for easier tracking of patient outcomes over time (Nieto-Martinez et al., 2024). In patients with complex comorbidities such as T2DM combined with CKD and heart failure, the application of NCP is particularly critical, as is allows clinicians to identify multiple nutrition problems simultaneously and prioritize interventions based on the patient's most urgent clinical needs. Despite its importance, case-based evidence of NCP implementation in patients with such complex clinical presentations remains limited in the Indonesian context. This study is therefore significant in providing a documented, real-world example of how NCP can guide clinical decision-making when patients presents with competing nutritional requirements, offering a replicable reference for dietitians managing similarly complex cases. this

The purpose of this study was to analyze the implementation of dietetic management using the NCP approach in patients with Type 2 Diabetes Mellitus accompanied by multiple comorbidities in a hospital in Surabaya City. This case study is expected to provide a practical overview regarding the integration of various dietary guidelines for patients with complex clinical conditions.

Method

This study was conducted during the Clinical Nutrition Internship Program at a hospital in Surabaya in November 2025. The research employed a descriptive study with a case study design involving one hospitalized patient diagnosed with Type 2 Diabetes Mellitus accompanied by multiple comorbidities. This patient was purposively selected due to the complexity of the clinical condition, which encompassed concurrent T2DM, CKD, heart failure, and multiple metabolic and infectious complications, making it representative and informative case foe examining NCP implementation in a challenging clinical scenario. Informed consent was obtained from the patient prior to data collection, and the study was conducted in a accordance with the ethical principles applicable to clinical nutrition internship practice. The case study approach was considered appropriate to provide a comprehensive description of the implementation of the Nutrition Care Process (NCP) in patients with complex clinical conditions.

Data were collected using interviews, a single 24-hour food recall (conducted once daily using a structured interview approach to capture the previous day's food comsumption), standardized Nutrition Care Process Guidelines (PAGT), and analysis of the patient's Electronic Medical Records (EMR). The study included nutritional assessment, nutrition intervention, monitoring, and evaluation stages. Monitoring was conducted for three days to evaluate dietary intake, biochemical parameters, and clinical conditions. It is acknowledged that this short monitoring duration represents a limitation of the study, as three days may not be sufficient to fully capture the long-term effects of the nutritional intervention. The collected data were analyzed descriptively to evaluate the implementation of the Nutrition Care Process (NCP) in the patient.

Results

Nutritional Assessment

In this case study, the patient was Mr. R, a 51-year-old retired male who was admitted to the hospital with complaints of swollen eyes (red and watery eyes), shortness of breath, generalized weakness, and leg edema for approximately two months. After clinical examination, the patient was diagnosed with Type 2 Diabetes Mellitus (T2DM), Chronic Kidney Disease (CKD), Heart Failure (HHF), hyperkalemia, hyperuricemia, urinary tract infection (UTI), pneumonia, and PNP. The patient had been diagnosed with diabetes mellitus for 26 years since the age of 25 years old. A family history of diabetes mellitus in the patient's mother and grandmother indicated a strong genetic risk factor.

Anthropometric examination showed that the patient had an ulna length of 25 cm and a mid-upper arm circumference (MUAC) of 30 cm. The estimated height based on ulna length was 162.1 cm, calculated using the formula 87.436 + (2.990 × ulna length). Meanwhile, the estimated body weight was 71.3 kg, calculated using the formula (2.863 × MUAC) − 14.533 (Mulyasari & Purbowati et al., 2018). Initial biochemical examination showed several abnormalities reflecting the complexity of the patient's clinical condition. This was supported by a hematocrit value of 32.4% (below the normal range of 35-47%) and a mean corpuscular volume (MCV) of 91.5 fl (within the normal range of 80-100 fl), confirming the normocytic pattern. The presence of acute bacterial infection and uncontrolled T2DM could worsen the infection and delay wound healing. The patient also experienced hyperkalemia and hyperuricemia, while elevated blood urea nitrogen (BUN) and creatinine levels indicated impaired kidney function affecting fluid regulation, electrolyte balance, and metabolite excretion.

The patient's dietary pattern was dominated by rice, animal protein sources (estimated at approximately 181% of protein requirements baed on SQ-FFQ), sweet snacks, and carbohydrate-dense foods. This patient was selected purposively as a representative case of complex comorbidities encountered during the clinical nutrition internship. Informed consent was obtained verbally from the patient prior to data collection, and the study was conducted in accordance with institutional clinical internship protocols. Therefore, dietary improvement was still required regarding food selection and portion adjustment to fulfill balanced nutritional requirements and support the management of T2DM and CKD

Table 1. Nutritional Assessment Results

Anthropometry

Parameter	Results	Normal Values	Interpretation
ULNA Length	25 cm	-	-
Estimated Height Based on ULNA	162.1 cm	-	-
Estimated Body Weight Based on MUAC	71.3 kg	-	-
MUAC	30 cm	-	-
%MUAC	93%	Obesity: >120%; Normal 90-110%; Mild Malnutrition; 60-90%; Severe Malnutrition:<60%	Normal

Biochemical Parameters

Parameter	Results	Normal Values	Interpretation
Hemoglobin	10.5 mg/dL	11.7-15.5 mg/dL	Low
Erythrocytes	3.54 x 10^6/uL	3.80-5.20 x 10^6/uL	Low
N/L ratio	35.44	<3.13	High
Serum Potassium	5.4 mmol/L	3.5-5 mmol/L	High

Clinical Physical Examination

Parameter	Results	Normal Values	Interpretation
General Appearance	GCS 456	GCS 14-15: Compos Mentis	Compos Mentis
Blood Pressure	173/82 mmHg	Normal: <120/80 mmHg	Hypertension
Respiratory Rate	24 breaths/minute	16-25 breaths/minute	Normal
Pulse Rate	86 breaths/minute	60-100 breaths/minute	Normal
Body Temperature	36.6 °C	36-37.5 °C	Normal
Head and Eyes	Red and watery eyes	No abnormalities	Red eyes observed
SpO_2	98%	96-100%	Normal

Food Recall

Parameter	Results	Requirements	Interpretation
Total energy	1,131.7 kcal (75%)	1,509.05 kcal	Moderete Deficit
Protein	66.12 g (100%)	66.12 g	Normal
Fat	44.85 g (100%)	44.85 g	Normal
Carbohydrate	155.34 g (75%)	207.12 g	Moderate Deficit

Nutrition Diagnosis

The nutrition diagnosis was established according to the patient's condition using the Problem-Etiology-Signs/Symptoms (PES) terminology as follows:

Table 2. Nutrition Diagnosis

Code	Nutrition Diagnosis
NI-1.2	Inadequate energy intake (P) related to decreased appetite (E) as evidenced by the patient's energy intake recall reaching only 75% of total requirements, categorized as a moderate deficit, and carbohydrate intake of 155.34 g (75%) (S).
NI-5.3	Decreased protein requirement (P) related to impaired kidney function (CKD) (E) as evidenced by elevated creatinine levels (1.9 mg/dL) and elevated BUN levels (23 mg/dL) (S).
NI-5.3	Decreased requirement for certain nutrients (sodium, potassium, and phosphorus) (P) related to impaired kidney function (CKD) and hypertension (E) as evidenced by elevated BUN (23 mg/dL) and creatinine levels (1.9 mg/dL), indicating impaired kidney function requiring restriction of specific micronutrients to prevent fluid retention and high blood pressure (173/82 mmHg) (S).
NB-1.1	Nutrition knowledge deficit (P) related to the patient never having received nutrition education regarding CKD + DM diet therapy (E) as evidenced by SQ-FFQ results showing excessive protein intake (181% of requirements), frequent consumption of sweet snacks, and carbohydrate intake exceeding requirements (S).

The nutrition diagnosis established were related to the clinical and intake domains. Since the patient had never received nutrition education previously, a behavioral domain nutrition diagnosis was also established to improve the patient's understanding regarding recommended and restricted foods according to the patient's current clinical condition.

Nutrition Intervention

Based on the established nutrition diagnoses, the dietary therapy provided to the patient consisted of a Diabetes Mellitus (DM) diet combined with a Low Protein (LP) diet. The patient's nutritional requirements were calculated using the PERKENI 2024 formula. The calculated nutritional requirements were 2,459.85 kcal of energy, 57,04 g of protein, 68.3 g of fat, and 318,2 g of carbohydrates.

The calculation of energy requirements considered stress factors (+10%), activity factors (+10%), and age factors (-5%). Protein requirements were calculated at 0.8 g/kg Body weight for patients with CKD, while fat requirements accounted for 25% of total energy intake. The remaining energy requirement, approximately 62% of total energy, was allocated to carbohydrates.

The dietary prescription for this patient required careful integration of guidelines for T2DM, CKD, and heart failure simultaneously. According to the KDOQI 2020 clinical practice guideline for Nutrition in CKD, protein intake for non-dialysis CKD patients should be restricted to 0.6—0.8 g/kg body weight per day to slow the progression of kidney disease while preventing protein-energy wasting (Ikizler et al., 2020). In this case, protein was set at 0.8 g/kg body weight, which represents the upper limit appropriate for patients with CKD accompanied by infections and metabolic stress. Regarding sodium management, restriction was also considered given the patient's concurrent hypertension and heart failure.

Monitoring and Evaluation

The following table presents the monitoring results of the patient's dietary intake over three days during hospitalization.

Table 3. Percentage of 3x24-Hour Food Recall Compared with Patient Nutritional Requirements

Requirements	Nutrients	Day 1	Day 2	Day 3	Average (%)
2,458.85 kcal	Energy (kcal)	2,249 kcal (91%)	2,317.3 kcal (95%)	2,347.8 kcal (98%)	94%
57.04 gram	Protein (g)	61.1 g (107%)	58.41 g (102%)	60.31 g (105%)	104%
68.3 gram	Fat (g)	62.51 g (91%)	67 g (98%)	65.2 g (95%)	94%
318.2 gram	Carbohydrate (g)	315.4 g (99%)	303 g (95%)	309.2 g (97%)	97%

Based on the monitoring results, the patient's energy intake progressively improved over the three-day observation period. Energy intake increased from 2,249 kcal (91%) on the first day to 2,317.3 kcal (95%) on the second day and 2,347.8 kcal (98%) on the third day. This improvement successfully resolved the patient's initial moderate energy deficit (75%) identified during the initial 24-hour food recall. It can therefore be concluded that patient was able to achieve energy intake close to the daily nutritional target.

The protein intake provided to the patient was restricted to 0.8 g/kg body weight as part of the low-protein diet for CKD management, with carefully controlled protein portions. Protein intake remained relatively stable at approximately 58–61 g/day (102–107%) compared with the target of 57 g/day. The addition of Nephrisol milk on days 2 and 3 was intended to support adequate daily protein intake without imposing excessive renal burden.

Fat intake fulfilled approximately 90–98% of the daily target. Fat intake was 62.51 g (91%) on the first day, 67 g (98%) on the second day, and 65.2 g (95%) on the third day, compared with the target of 68.3 g/day. Carbohydrate intake reached 99% of the target on the first day, 95% on the second day, and 97% on the third day. These values remained within the recommended range (90–110%). Stable carbohydrate intake may help prevent catabolism and maintain adequate energy intake without increasing protein consumption. The improvement in carbohydrate intake was influenced by the patient's progressively improving appetite.

Table 4. Development of Patient Dietary Therapy

Day	Type of Diet	Food Texture
1	DM + LP	Soft Rice
2	DM + LP + Nephrisol Milk	Soft Rice
3	DM + LP + Nephrisol Milk	Soft Rice

The DM + LP soft diet was consistently provided for three days without any modification to the type of diet, with 100% dietary compliance observed (no food residue remained during the patient's Comstock monitoring). The addition of Nephrisol milk on days 2 and 3 was intended to optimize the patient's energy and protein intake in accordance with the patient's CKD condition. The selection of soft-textured soft rice was based on the patient's clinical condition and nutritional needs. Soft-textured food was provided to facilitate chewing and swallowing. Considering that the patient initially complained of generalized weakness, which could reduce the willingness to chew, soft rice was provided to minimize the risk of dysphagia and pneumonia complications.

Table 5. Results of Patient Biochemical Monitoring for Three Days

Parameter	Initial	Normal Values	Day 1	Day 2	Day 3
Hemoglobin	10.5 mg/dL	11.7-15.5 mg/dL	-	-	11.2 mg/dL
Erythrocytes	3.54 x 10^6/uL	3.80-5.20 x 10^6/uL	-	-	3.81 x 10^6/uL
Leukocytes	12.41 x 10^3/uL	3.6-11 x 10^3/uL	-	-	7.61 x 10^3/uL
Serum Potassium	5.4 mmol/L	3.5-5 mmol/L	-	3.9 mmol/L	-

Based on the patient's biochemical examination results from the first to the third day, there were no highly significant changes observed. At hospital admission, the patient showed normocytic normochromic anemia, which commonly occurs in patients with infections and CKD. This condition was indicated by low hemoglobin, erythrocyte, and hematocrit levels, while the patient's MCV and MCH values remained within the normal range. Elevated leukocyte, neutrophil, and N/L ratio levels accompanied by low lymphocyte levels were consistent with the patient's clinical condition, including acute bacterial infection, pneumonia, urinary tract infection (UTI), diabetic foot ulcer, and PNP condition. Several biochemical parameters showed improvement toward normal values on the second and third days of monitoring. The patient's hemoglobin level improved from 10.5 mg/dL to 11.2 mg/dL on the third day, which was categorized as normal. Erythrocyte levels also increased from 3.54 × 10^6/uL to 3.81 × 10^6/uL, reaching the normal range. Leukocyte levels, which were initially elevated at 12.41 × 10^3/uL, decreased to 7.61 × 10^3/uL and returned to normal values. Meanwhile, serum potassium levels decreased from 5.4 mmol/L to 3.9 mmol/L on the second day of monitoring, indicating normalization of potassium levels.

Table 6. Results of Patient Clinical Physical Monitoring for Three Days

Clinical / Physical Parameters	Day 1	Day 2	Day 3
Blood Pressure	173/82 mmHg	136/72 mmHg	132/61 mmHg
Respiratory Rate	24 breaths/minute	20 breaths/ minute	21 breaths/minute
Pulse Rate	86 beats/minute	80 beats/minute	88 beats/minute
Body Temperature	36.6°C	36.3 °C	36.4 °C
Head and Eyes	Red and Watery eyes	Eyes still red but no longer watery	Redness reduced, no watery eyes

Based on the clinical physical examination results, the patient showed progressive improvement in vital parameters, indicating improvement in the patient's overall clinical condition. The patient's blood pressure decreased from 173/82 mmHg on the first day to 132/61 mmHg on the third day. The patient's respiratory rate remained relatively stable between 20–24 breaths/minute, which was still within the normal range. Pulse rate remained stable at 80–88 beats/minute (normal), while body temperature was relatively stable between 36.3–36.6°C. The patient's GCS score remained 456, indicating a consistently compos mentis condition. Complaints related to red and watery eyes also gradually improved during the monitoring period.

The progressive in blood pressure from 173/82 mmHg on day one to 132/61 mmHg on day three reflects a clinically meaningful improvement that aligns with the goals of integrated dietary and pharmacological management in this patient. From a nutritional perspective, adherence to a sodium restricted diet as part of the DM + LP dietary regimen likely contributed to this improvement by reducing fluid retention and vascular resistance (Chrysohoou et al., 2022). This finding consistent with evidence that dietary sodium restriction, when implemented appropriately and in conjunction with antihypertensive therapy, can contribute to better blood pressure control in patients with CKD and heart failure. The sustained improvement in blood pressure over three consecutive days also suggests that the patient responded well to the combined nutritional and medical interventions provided during hospitalization.

Conclusion

In this case study, the implementation of clinical nutrition care using the Nutrition Care Process (NCP) approach was associated with improved dietary intake and favorable changes in several clinical and biochemical parameters during the three-day observation period. Energy intake increased from an initial moderate deficit to an average of 94% of requirements, while serum potassium levels decreased from 5.4 mmol/L to 3.9 mmol/L and blood pressure improved from 173/82 mmHg to 132/61 mmHg. These findings suggest that individualized nutrition care may support short-term nutritional and clinical improvement in patients with Type 2 Diabetes Mellitus and multiple comorbidities. However, the findings should be interpreted cautiously because they are based on a single case with a short observation period.

Recommendation

Based on the implementation of clinical nutrition care in patients with Type 2 Diabetes Mellitus complicated by chronic kidney disease and heart failure, continuous nutritional status monitoring during hospitalization is necessary to ensure adequate energy and nutrient intake according to the patient's condition. Healthcare professionals, particularly clinical dietitians, are expected to continue implementing the Nutrition Care Process (NCP) approach so that nutritional interventions can be more focused, measurable, and tailored to the patient's clinical condition and nutritional needs.

Furthermore, nutrition education for both patients and their families should be improved to support adherence to dietary management adjusted to the patient's condition and nutritional requirements. Continuous nutrition education is expected to help patients maintain appropriate dietary patterns after hospital discharge, thereby preventing disease progression and reducing the risk of further complications. Future studies are recommended to involve larger sample sizes and longer monitoring periods to obtain more generalizable and comprehensive evidence on the effectiveness of NCP-based nutritional interventions in patients with T2DM and complex comorbidities.

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