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Development of Nutrant Application Based on Android Platform for Individual Nutrition Assessment

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Abstract
The nutritionist should keep abreast of technological developments to improve information on nutritional needs and assessment of individual nutritional status, supporting efficient community and clinical nutrition reporting, which can facilitate nutrition assessment and intake monitoring. This study aims to develop and evaluate the functionality and usability of an Android-based nutrition assessment application, NutrAnt, for individual nutrition assessment. The design used a Research and Development (R&D) model conducted in Banda Aceh City and Aceh Besar from April - December 2023. The subjects involved 53 nutritionists and nutrition experts who were purposively selected. The method used is the Waterfall Models which consists of four stages: problem identification, system design, system development, and system testing. Application testing is done with blackbox testing and usability testing. Results showed high functionality ratings, with an 85.5% satisfaction score from Health Office nutritionists and a 90.0% score from a team of nutrition experts. NutrAnt proves to be a valuable tool, significantly enhancing the capabilities of nutritionists in assessing patient nutritional needs both in community and clinic settings. Future development should consider expanding the app's functionalities and adapting it for a broader user base. This innovation offers a practical advancement in digital tools for nutrition assessment, with promising implications for improved nutritional care and reporting.

Keywords: Nutrition Application, Nutritional Needs, NutrAnt, Consumption Assessment.

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1. INTRODUCTION

The development of health requires good health management supported by the availability of health data and information that is relevant, timely, accurate, and in accordance with the needs of health programs. Health information needs include all data from various health sectors, especially nutrition data and other sectors (Grover et al., 2019). The development agenda until 2030 is to end all forms of malnutrition, including achieving the 2025 international targets for reducing stunting and wasting problems in children under five (Rahimi et al., 2018).

The nutritional situation of Indonesia has high disparities between provinces (Lau et al., 2011). Therefore, the national health condition in Indonesia is still an important program that is currently unresolved (Smith et al., 2020). Indonesia is recorded as one of the 17 countries that suffer from the double burden of overnutrition and malnutrition. One of the development goals to be achieved in the National Medium-Term Development Plan for Health 2020-2024 is to reduce the incidence of stunting to 14% and the rate of wasting to 7%, and to reduce the prevalence of non-communicable diseases (Saing et al., 2023).

Several researches have reported that specific intervention approaches such as family-based management of malnourished children are one of the efforts to improve under-five nutrition such as stunting, undernutrition, malnutrition and overweight (Grover et al., 2019; Rahimi et al., 2018; Lau et al., 2011). Monitoring the nutritional status of children under five and monitoring the growth and development of children under five requires effective family participation and involvement. Effective and efficient early detection of child growth and development can use web-based applied media and smartphones (Meri et al., 2019). The use of smartphones has become an important part of a healthy world. The impact is very supportive of health services and health promotion (Zorbas et al., 2018). Family participation has a positive impact on nutrition workers in monitoring and evaluating nutrition problems (Lau et al., 2011). Therefore, the need to know the amount of nutrients needed by the body and the nutritional status can be calculated through the NutrAnt application is very important in minimizing nutritional problems.

A few research results related to the use of Android-based applications to conduct Nutritional Assessment, namely research by Trullàs et al., 2022, reported that the development of the application has helped users in China to increase their understanding of food intake and optimize their diet (Trullàs et al., 2022). The same thing was reported by Vélez-Ruiz et al. in 2019, in Spain that the use of nutrition assessment applications can improve nutritional knowledge and nutritional status in adolescents. In Canada, the use of an android-based application in monitoring children's nutritional status and consumption significantly improved their nutritional status (Greenhalgh et al., 2017).

These studies show that the Android-based Nutrition Assessment application has the potential to improve nutrition knowledge, healthy eating behavior, and nutritional status in users. The development of the NutrAnt application is able to conduct a child nutrition assessment that is beneficial to the availability of information about consumption and growth stimulation in toddlers, provides consumption features (energy and nutrient requirements), and will make it easier for nutritionists or other health workers to provide counseling related to the growth and development of toddlers, as well as documentation of the results of monitoring their growth and development.

The NutrAnt application is designed specifically for the Indonesian context and the specific needs of local nutrition workers. NutrAnt is an application based on the Android platform that aims to facilitate the process of individual nutritional assessment. The app provides various features that support the collection, analysis, and reporting of nutrition data quickly and accurately. With a user-friendly interface, NutrAnt is expected to be used by nutrition workers easily without requiring complex technical training.

This study was conducted to design and develop a prototype of a nutrition assessment application (NutrAnt) on smartphones based on the Android platform. The specific objectives

of this study were to, identify user needs and requirements, design application interfaces and functionality, develop prototypes, and test application functionality.

2. RESEARCH METHOD

The research used a Research and Development (R & D) design, through the Waterfall Model method approach (Requirements, Analysis, Design, Coding and implementation, Testing, Operation and deployment, and Maintenance) in developing the NutrAnt application. The research location is in the area of the Banda Aceh City Health Office and Aceh Besar. The city of Banda Aceh has complex nutritional problems, both obesity, diets that tend to be Westernized, and the number of fast food outlets that allow people to be at risk of non-communicable diseases (NCDs). The research was conducted from April to November 2023. The sample in this study consisted of nutritionists and nutrition experts from the working area of the Health Office of Banda Aceh City and Aceh Besar District, totaling 53 people taken purposively. The sample size in this study was calculated using the equation below, where n= The number of samples required, Z= The desired significance level of 95% = 1.96, p= The proportion of the population that has certain characteristics = 82.5, and e= Margin of error = 10%:

$$n = \frac{\left[Z_{1-\alpha}{}^{2}(P * (1-P)\right]}{e^{2}}$$

The sample for this study was purposively selected, involving 53 nutritionists working at the Health Office of Banda Aceh City and Aceh Besar District. The region was chosen due to the complexity of nutrition problems, such as obesity, westernized diets, and the high number of fast food outlets that increase the risk of non-communicable diseases (NCDs). The participation of health workers was considered important to provide input related to the needs and evaluation of the function and benefits of the NutrAnt application in nutritional assessment in high-risk areas. Inclusion criteria included nutritionists working at the Banda Aceh and Aceh Besar Health Offices, having at least 1 year of work experience, willing to participate in all stages of the study, and able to use an Android device to access NutrAnt. Exclusion criteria included respondents who had difficulty using Android devices or were not willing to follow the full research procedures.

This research uses the Research and Development (R&D) method with the Waterfall model approach, which consists of the following stages:

1. Problem identification and data collection: At this stage, researchers identified user needs and problems faced in nutrition assessment. Data was collected through interviews and field observations of nutritionists in the Banda Aceh and Aceh Besar City areas to understand the existing constraints.
2. System design: Based on the data obtained, the researcher designed the NutrAnt application framework, including the structure, interface, and key features needed to fulfill the users' needs. Flowcharts, data models, and interface designs were developed to make the application intuitive and easy to use by health workers.
3. System development (coding and implementation): At this stage, the NutrAnt application was developed using a programming language that supports the Android platform. Features such as nutritional status assessment and nutrient intake monitoring were created and implemented. The initial implementation was tested internally by the development team to ensure all major components were working as designed.
4. System testing: Testing was conducted in two forms, namely Blackbox testing: This test is conducted to ensure that all application functions run as required, without looking at the internal code. All features are tested to check whether the application can run as expected by the user. Usability testing: This test involves nutrition workers who are the target users to provide feedback on ease of use, interface comfort, and general satisfaction in using the

application. Assessment was done on the appearance, navigation, and overall functionality of NutrAnt.

5. Operation and deployment: After testing was completed, the NutrAnt application was uploaded to the Play Store to be accessible to users in Banda Aceh and Aceh Besar. At this stage, the researcher conducted initial monitoring of the application to ensure the installation and use of the application went smoothly and made quick fixes if problems were found.

6. Maintenance: Maintenance is carried out to address bugs that may be found after the application is used more widely. Regular improvements and updates are made based on feedback from users, including adding additional features according to the needs of nutrition workers. This maintenance aims to ensure that the application continues to be relevant and can be used optimally by nutrition workers in the long term.

Data analysis in the development of application products in the form of descriptive data, namely reviews, and suggestions from material experts and media experts in accordance with the development procedures carried out. Data analysis is carried out on the results of development by collecting references regarding human interaction material with NutrAnt devices/applications carried out consisting of data reduction stages (data reduction), data presentation (data display), and conclusion drawing (conclusion: verifying). Data from observations and interviews with nutritionists will be analyzed quantitatively, namely in determining the level of human interaction material with the NutrAnt device/application. Namely in determining the quality level of the NutrAnt application based on the value of functional suitability, performance efficiency, usability, and reliability characteristics.

This research has obtained ethical approval from the Health Research Ethics Commission (HREC) of the Poltekkes Kemenkes Aceh, on June 12, 2023, with the number: LBH.02.03/043/2023.

3. RESULTS AND DISCUSSION

The study was conducted in the area of Aceh Besar Health Office and Banda Aceh City, all Puskesmas were included in the unit of analysis and 53 subjects were taken consisting of nutrition personnel at the Health Center, experts, and the Health Office. Table 1 presents the subject characteristics based on age, gender, education, and similar training attended.

Table 1. Distribution of study subject characteristics

Characteristic	Frequency	Percentage (%)
Age		
25 - 34 years	20	37,5
35 - 50 years	33	62,5
Gender		
Male	11	20,8
Female	42	79,2
Education		
D-III Nutrition/Health	15	29,2
D-IV Nutrition/Health	23	41,7
Bachelor's Degree in Nutrition/Health S-2	11	20,8
Nutrition/Health	4	8,3
Nutrition Training		
Yes	44	83,3
No	9	16,7

Table 1 presents that this study involved 53 nutrition personnel with the majority of subjects aged 35-50 years (62,5%), and the rest aged 25-34 years (37,5%). In terms of gender, the majority of subjects were female (79,2%). In terms of education, the majority of subjects

had a D-IV Nutrition/Health education (41,7%), while others had a D-III Nutrition/Health education (29,2%), S-1 Nutrition/Health (20,8%), and S-2 Nutrition/Health (8,3%). Most of the subjects had attended nutrition training (83,3%). These results provide an overview of the demographic characteristics and educational background and training of the research subjects (nutritionists) in nutrition/health.

Modules in the NutrAnt App

The NutrAnt application developed consists of four main modules designed to facilitate nutritionists in conducting individual nutrition assessments more efficiently and accurately. The following is an interpretation of the research results based on each application module:

Figure 1. NutrAnt application main page view

Module 1: About Us

The About Us module serves as an introduction to the NutrAnt application, which is based on the Android platform. This module maps the purpose and function of the application in conducting consumption assessments and calculating energy and nutrient requirements. The use of this module allows users to understand the background and benefits of the application, which can increase user trust and acceptance of this new technology.

Module 2: Calculator

The Calculator module is the core of the NutrAnt application, providing various tools to calculate consumption needs and conduct nutritional assessments. The tools provided include Body Mass Index (BMI) calculator, Health Card monitoring, calculation of energy and nutrient requirements using Harris-Benedict and Mifflin formulas, and anthropometric calculations. With this module, nutritionists can perform various calculations relevant to consumption assessment for both individuals and groups. The ease of access and accuracy of calculations provided by this module can reduce manual errors and improve the work efficiency of nutrition workers.

Module 3: Meal Planner

The Meal Planner module is an excellent feature that allows users to record and analyze individual food and beverage consumption over the past 24 hours. The module uses the Indonesian Food Composition Table (IFCT) as a reference, ensuring that the data used is accurate and in line with national standards. Through the 24-hour Food Recall method, users can calculate the budget of calories, protein, carbohydrates, fat, as well as other nutrients both macro and micro. This module not only helps in recording consumption but also in planning and evaluating nutrient intake, which is very important in nutrition intervention programs. The accuracy and ease of use of this module can help nutritionists in providing more precise and personalized dietary recommendations.

Module 4: Profile

The Profile module stores the biodata of the measured and assessed subjects. The information stored in this module includes relevant personal data and medical history, which can be used to customize nutrition recommendations based on the individual's profile. By storing this data, the app can provide a more targeted and personalized nutrition assessment. In addition, this module allows users to monitor changes in nutritional status over time, providing a more comprehensive picture of an individual's nutritional health.

The development of the NutrAnt application, which consists of four modules, demonstrates a comprehensive approach to supporting the work of nutritionists. Each module is designed to meet specific needs in the nutrition assessment process, from user education, nutrient requirement calculation, and consumption recording, to individual profile data storage. The integration of these features in one application allows nutritionists to perform their tasks more efficiently and accurately. The main advantages of this application are:

1. Efficiency and accuracy. NutrAnt app reduces manual errors and saves time usually spent on manual calculations and record keeping. With the calculator and meal planner features, nutritionists can conduct nutrition assessments more quickly and accurately.
2. Ease of use. The user-friendly interface ensures that the app can be used by nutrition workers with varying levels of technological skills. Education through the About Us module helps users understand the functions and benefits of the app.
3. Integrated data. The Profile module allows storage and easy access to individual data, which is important for long-term monitoring and evaluation. Integrated data also supports the creation of more personalized and accurate nutrition recommendations.
4. Nutrition program support. With features that support nutrition assessment and planning, the NutrAnt app can serve as an important tool in nutrition intervention programs, both at the individual and community level.

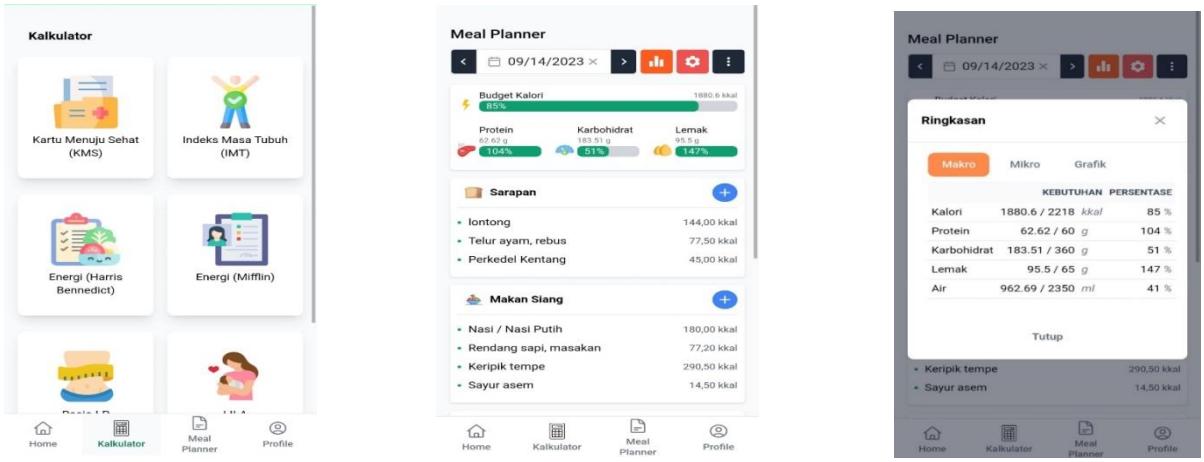

Figure 2. The main page view consists of the Calculator Module, Meal Planner, and nutrient analysis.

Functional NutrAnt Application

The results showed that the NutrAnt App has been successfully developed and is available for use by nutrition workers in Banda Aceh City. The functional appropriateness assessment showed mixed results, with nutritionists at the health office and nutritionists giving different ratings. However, the nutrition expert team gave a more positive assessment, especially in aspects such as functional appropriateness, accuracy, suitability, and reliability. The assessment of the functional appropriateness of the NutrAnt App was conducted by two groups of assessors, namely nutritionists in the health office along with nutritionists, who gave a functional appropriateness assessment of 85,5%. Furthermore, a team of nutrition experts gave a higher assessment for several aspects, with a suitability score of 90,0% for functional appropriateness, accuracy, suitability, and reliability.

This research resulted in the NutrAnt App which is a potential tool in improving nutrition understanding, healthy eating behavior, and growth monitoring of toddlers and adults in Banda Aceh City. Although there were differences in the functional suitability assessment, the nutrition expert team gave a higher rating to the NutrAnt App. The following is a view of the NutrAnt application.

DISCUSSION

NutrAnt Application Module Readiness

The developed NutrAnt application includes four main modules designed to help nutritionists conduct individual nutrition assessments more efficiently and accurately. This development is a significant step in supporting nutrition health programs, both at the individual and community levels. The four modules are About Us, Calculator, Meal Planner, and Profile. The About Us module serves as an introduction to the NutrAnt application based on the Android platform, explaining the purpose and function of the application in assessing consumption and calculating energy and nutrient requirements. This module is also important to increase user trust and acceptance of new technology. According to (Chan et al., 2019), initial education about the benefits and how to use health apps is essential to increase their adoption and effectiveness.

Therefore, the About Us module plays an important role in educating users about the importance of accurate and efficient nutrition assessment. With a comprehensive explanation of how the app can assist in nutritional assessment, this module plays an important role in educating users on the importance of accurate and efficient nutritional assessment. The calculator module is the core of the NutrAnt application, which provides various tools for calculating consumption needs and conducting nutritional assessments. Available tools include a Body Mass Index (BMI) calculator, monitoring of the Health Card, calculation of energy and nutrient requirements using the Harris-Benedict and Mifflin formulas, and anthropometric calculations. According to research by (Burgess et al., 2020), the use of technology in nutrition assessment can reduce manual errors and improve work efficiency. The Calculator module allows nutrition workers to perform various calculations relevant to consumption assessment for both individuals and groups, thereby reducing manual errors and improving calculation accuracy.

The NutrAnt application is designed to facilitate nutrition workers in conducting nutrition assessments more efficiently and accurately. In this application, two main modules, the Calculator and Meal Planner, play a key role in calculating and assessing individual energy and nutrient requirements. The Meal Planner module is the flagship feature that allows users to record and analyze an individual's food and beverage consumption over the past 24 hours. The module uses the Indonesian Food Composition Table (IFCT) as a reference, ensuring that the data used is accurate and in line with national standards. Through the 24-hour Food Recall method, users can calculate the budget of calories, protein, carbohydrates, fat, and other nutrients both macro and micro. Research by Thompson et al. (2018), showed that the 24-hour

Food Recall method is one of the most effective methods for assessing food intake. The accuracy and ease of use of this module helps nutritionists provide more precise and personalized dietary recommendations. In addition, the module is also able to calculate the number of calories and nutrient content of foods consumed, assisting in planning and evaluating daily nutrient intake (McClung et al., 2018). In terms of menu planning, this module will assist in planning a daily or weekly menu that is suitable for individual nutritional needs based on the data that has been entered (assessment) (Carvalho et al., 2021).

Moreover, it is also important to mention that the continuity between these two modules (Calculator and Meal Planner) in the NutrAnt application lies in how they complement each other to provide accurate and personalized nutrition assessment. The Calculator module collects basic data such as BMI, daily calorie requirements, and anthropometric parameters, which form the basis for determining individual nutritional needs. This data is then used by the Meal Planner module to create an appropriate menu plan, ensuring that the menu meets the calculated daily calorie requirement. In addition, the Calculator module provides a tool for calculating energy and nutrient requirements, which is necessary for initial assessment, while the Meal Planner module allows users to record food intake and compare it to calculated requirements, assisting in the evaluation and adjustment of food intake. The Calculator module generates data that can be used to customize individual diet plans, and the Meal Planner module uses these results to customize daily menus, ensuring meal plans are personalized and in line with individual nutritional needs. Finally, the Calculator module sets nutritional targets that can be monitored and evaluated through the Meal Planner, which records daily intake and provides feedback to update calculations and planning as necessary.

Next to the last is the Profile Module, which stores the biodata of the subject being measured and assessed. The information stored includes relevant personal data and medical history, which can be used to customize nutrition recommendations based on the individual's profile. Studies by Gibbons et al. (2022), show that personalization in nutrition recommendations can improve adherence and health outcomes. The module allows users to monitor changes in nutritional status over time, providing a more comprehensive picture of an individual's nutritional health. The integrated data supports the creation of more personalized and accurate nutrition recommendations.

Benefits of NutrAnt Application

Some of the advantages of using the NutrAnt application by nutrition workers are efficiency and accuracy, ease of use, integrated data, and support for the implementation of nutrition programs. In terms of efficiency and accuracy, the NutrAnt application reduces manual errors and saves time that is usually spent on manual calculations and record keeping. With the calculator and meal planner features, nutritionists can conduct nutrition assessments more quickly and precisely. According to Ye et al. (2019), digitization in nutrition assessment can significantly improve efficiency and accuracy. As for ease of use, the application's user-friendly interface ensures that it can be used by nutritionists with varying levels of technological skills. Education through the About Us module helps users understand the functions and benefits of the app. According to Tan et al. (2020) showed that ease of use is a key factor in health technology adoption

The NutrAnt application has enabled integrated use of data. For example, the Profile Module allows storage and easy access to individual data, which is important for long-term monitoring and evaluation. The integrated data also supports the creation of more personalized and accurate nutrition recommendations. Middleton et al. (2019), stated that health data integration improves the quality of care and health outcomes.

It is important to note that the NutrAnt application is expected to support nutrition programs at the health department sector as well as the Health Center level. With features that support nutrition assessment and planning, the NutrAnt application can serve as an important

tool in nutrition intervention programs, both at the individual and community levels. Tan et al. (2020), showed that application-based technology can strengthen public health programs.

Functional NutrAnt App

The study has reported that the NutrAnt App was successfully developed and ready to be used by nutrition workers in Banda Aceh City. The results of the functional appropriateness assessment showed variations among the assessment groups, with the nutrition workers in the health office and the Nutrition Implementation Team giving mixed ratings. In contrast, the nutrition expert team gave higher ratings, especially in aspects such as functional appropriateness, accuracy, suitability, and reliability. Although the application has been well received, there is still room for improvement, especially in terms of understanding and use in the field (Fink et al., 2020).

The NutrAnt application shows great potential in supporting nutrition workers in their work, especially in monitoring community or individual consumption. The use of this application can improve efficiency and accuracy in nutritional assessment, as well as assist in providing more personalized dietary recommendations. According to a study by (Paglialonga et al., 2023), digitization in nutrition assessment can significantly improve efficiency and accuracy, which is in line with the findings of this study. The difference in ratings between the nutrition staff at the health office, the nutritionist, and the nutrition expert team can be explained by the different understanding and experience of each group. The nutrition expert team, with a more in-depth background and understanding of nutrition assessment, tended to give higher ratings. This suggests that a better understanding of the functions and benefits of the app may influence the perception and acceptance of new technology. The study by Chan et al. (2019) emphasizes the importance of early education on the benefits and usage of health apps to increase their adoption and effectiveness (Chan et al., 2019).

The NutrAnt app has the potential to be a very useful tool in nutrition practice. By providing tools to calculate energy and nutrient requirements, as well as enabling recording and analysis of food consumption, the app can assist nutritionists in providing appropriate and personalized dietary recommendations. According to research by Thompson et al. (2018), digital methods such as health apps can help in recording food consumption more accurately and efficiently (Thompson et al., 2018). Although the results of this study suggest that the NutrAnt App has great potential, further research is needed to understand the differences in ratings between the assessment groups and ensure the app can be used effectively by nutrition workers in the field. Gibson et al. (2022) point out that personalization in nutrition recommendations can improve adherence and health outcomes, so it is important to ensure that this app can be tailored to the individual needs of users (Gibbons et al., 2022).

The NutrAnt application that has been developed has several limitations, namely functionality limitations, where the NutrAnt application was developed with basic main features, such as calculating nutritional needs and recording daily consumption. However, this application has not accommodated several additional health parameters or integration with other devices that can enrich nutritional data. In addition, the app was only tested using blackbox and usability methods, which may not be sufficient to assess the app's performance in various usage situations. NutrAnt is still Android-based, which may not be accessible to users with non-Android devices (such as iPhones). This limits the app's user reach and reduces the potential for wider adoption.

4. CONCLUSION

The development of the NutrAnt application, which consists of four modules, demonstrates a comprehensive approach in supporting the work of nutrition workers. Each module is designed to meet specific needs in the nutrition assessment process, from user education, nutrient requirement calculation, consumption recording, to individual profile data

storage. The integration of these features makes it easier for nutrition workers to perform their duties more efficiently and accurately.

However, the results of this study also show that NutrAnt still needs improvement, especially in terms of additional features to expand the nutrition assessment function and integration of data from other sources, as well as cross-platform compatibility. In addition, long-term testing is needed to evaluate the reliability of the application under daily use conditions. Recommendations for further development include the addition of additional health features, compatibility with non-Android devices, as well as an improved maintenance system to ensure sustainability and improved application performance. NutrAnt has great potential to support nutrition and health programs in Indonesia if these developments can be implemented

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