Cendana International Conference on Social and Technology (CICoST)
CISoST - 2025
E-ISSN: **3047-2490**
Oktober 2025
Page: **086 – 091**

Expert System and Artificial Intelligence For Diagnosing of Anemia: A Literature Review

Sri Muliana Putri Bakara[1*], Siti Nurmawan Sianga [2], Herna Rinayanti Manurung[3], Imran Saputra Surbakti[4], Rosmani Sinaga[5]
[1-5]Midwifery Study Program, STIKes Mitra Husada Medan, Medan, Indonesia
Email: [1*]srimulianaputri@mitrahusada.ac.id , [2] sitinurmawan@mitrahusada.ac.id , hernarinayanti@mitrahusada.ac.id, imransurbakti@mitrahusada.ac.id , rosmanisinaga@mitrahusada.ac.id

Abstract

The development of artificial intelligence can now be used as one method for diagnosing diseases, including anemia. Anemia is a condition where there is a deficiency in hemoglobin (Hb) levels in the blood and is a disease commonly experienced by all segments of society. The main function of Hb in the blood is to transport oxygen and provide energy for cells. If Hb levels are below normal, symptoms such as fatigue will appear because organs do not receive what they need to function properly. Therefore, artificial intelligence is needed for simple and practical anemia diagnosis, utilizing technological advancements. Research Methods: The analysis was conducted using a literature review method, which involved comprehensively reviewing, identifying, examining, and presenting information, along with data review. Research Findings: The best methods in this literature review are Rule-Based Web with 83% sensitivity accuracy, a portable ocular conjunctival system assisted by Smartphone with 77.58% sensitivity, and Support Vector Machine (SVM) with the highest accuracy of 72.9167%. Conclusion: Based on this literature review, methods were found that can be used for faster, cheaper, globally applicable, and quite popular early diagnosis of anemia, replacing doctors' visual examinations for anemia diagnosis. Such a system would be very useful in rural areas of developing countries, where medical resources are difficult to access.

Keyword: Artificial Intelligence, Expert Systems, Anemia, Haemoglobin, Diagnose.

1. INTRODUCTION

In the development of time, especially technology is an important part, including in the medical field. In general, technology will transform input into output. Using a process, namely transformation. Medical technology in general also follows the characteristics of technology. Focusing on the semi-automatic level, technology in the medical world can be used as a search tool, for scanning, or in some cases will generating data so that these results can help medical professionals in diagnosing or making decisions. (Halim & Mudjihartono, 2022)

Research on artificial intelligence, particularly in the medical field, is a dynamic area that has been rapidly developing recently. Artificial Intelligence (AI) is a term used to model intelligent behavior and critical thinking comparable to human using computers and technology. (Sastypratiwi & Nyoto, 2020) Expert systems are a part of Artificial Intelligence (AI). The basic idea behind an expert system is to make it easier for experts with specific knowledge to transfer that knowledge into a computer. Expert systems have developed across various subjects, including medical science. Expert systems have various advantages over human expertise because they are affordable, permanent, consistent, fast, and replicable. Human expertise, on the other hand, is easily damaged, unpredictable, expensive, and slow in processing and development. (Sastypratiwi & Nyoto, 2020) Many industries are researching to determine the best utilization of artificial intelligence (AI) technology, and healthcare is no exception. One of the applications of AI in the world medicine, specifically in diagnosing anemia.

Anemia is one of the major nutritional problems in Asia, including Indonesia. Anemia is a condition where the hemoglobin (Hb) level in the blood is lower than the normal value. Anemia is common in school-aged children, with the highest prevalence found in Southeast Asia, where an estimated 60% of children are anemic. Anemia is most frequent in preschool children, adolescents, and pregnant and breastfeeding women, with a prevalence ranging from 80-90%. (Yanti et al., 2022) Anemia in pregnant women is a serious problem that can lead to complicated pregnancies, premature births that can cause death, and low birth weight (LBW).

Anemia monitoring in pregnant women is quite a phenomenon for midwives and healthcare professionals due to the limited time available to make an accurate diagnosis. Late diagnosis leads to delayed results in treatment. The resulting diagnosis is displayed as is. (Veronica et al., 2021). In an embryology laboratory, AI, with its focus on gametes and embryos, can avoid the risk of IVF failure for patients. The application of AI in the laboratory is to improve and automate embryo quality analysis through image analysis, with the main goal being to predict Successful implantation is particularly crucial in the In Vitro Fertilization (IVF) cycle. (Trolice et al., 2021) Although many people suffer from anemia, there is no specific method to test for it. In most cases, anemia is identified incidentally in situations where patients are asked to have their blood tested to diagnose another illness. The conventional process for assessing blood to check hemoglobin levels requires more time and effort. This is usually done by using a patient's blood sample, observing it on a microscope slide under a microscope, and counting each type of distorted cell separately.

Therefore, it requires a lot of time and highly trained medical practitioners and equipment. Furthermore, this technique causes pain for patients and those who are hesitant to have regular blood tests to check their hemoglobin levels. And the blood testing environment must be clean and safe, but developing and poor countries

E-ISSN: 3047-2490
Oktober 2025
Page: 086 – 091

often conduct these tests in such environments. Which is relatively unclean, posing a very high risk of infection. The aforementioned process is expensive for hospitals and patients. (Jayakody & Edirisinghe, 2020) In this Expert System, artificial intelligence (AI) related to anemia will be presented, which is expected to assist in the early diagnosis of hemoglobin levels and in identifying the causes and overall data processing regarding anemia.

2. RESEARCH METHOD

The method used is a literature review with analytical steps to summarize the topic from various library sources, with the aim of increasing understanding of the discussed topic. The data sources used in this article were collected from primary sources, including scientific journals (both national and international), and tertiary sources, such as reputable websites. Data sources were searched through websites such as Pubmed, NCBI, Elsevier, Google Scholar, and others. The keywords used in this literature review are as follows: Expert System, Sistem Pakar, Artificial Intelligence, Kecerdasan Buatan, Anemia. The search results yielded 1,700 articles relevant to the keywords. Then, 10 articles considered relevant were selected according to the inclusion criteria. The criteria Inclusion in this journal refers to scientific articles and journals that discuss artificial intelligence (AI) related to the early diagnosis of anemia. With the novelty of articles from the last 5 years. The analysis was conducted using the literature review method, which involved examining, identifying, reviewing, and presenting the information. Before the presentation process, the material explained previously was first combined, reviewed, and the results presented in the article were compared, followed by drawing appropriate conclusions.

3. RESULT AND DISCUSSION

Relevant studies show that an expert system on artificial intelligence (AI) designed with the implementation of several AI methods can be used to assist in the diagnosis of anemia. Based on the 10 pieces of literature we obtained, which have been tested against experts and the system, the accuracy level of the system based on the validation results of experts and the system can be used as a reference in the early diagnosis of anemia. The explanation regarding artificial intelligence (AI) for anemia is presented in this table

Table 1. Artificial Intelligence in Anemia Diagnosis

No	References	Artificial Intelligence	Results And Discussion
1	**Authors:** Jayakody, J. A. D. C. A., & Edirisinghe, E. A. G. A. **Title:** Hemo-Smart: A Non- Invasive, Machine Learning Based Device And Mobile App For Anemia detection **Year: 2020**	*A non-invasive device called "HemoSmart" to detect anemia*	The output from the mobile application and sensor devices is used to predict whether or not the user has anemia. Through this application, users can monitor their hemoglobin levels over a certain period of time and take the necessary actions. The advantage is that it is Android-based and the actions taken do not cause any wounds to the patient, thereby reducing the risk of infection. The final result of this research is a smart non-invasive anemia detection device along with a mobile application that can determine changes in a person's physical symptoms using a pre-determined questionnaire. This device will be able to identify patients with anemia at the earliest possible stage. The target market for this device is hospitals, health clinics, large pharmaceutical companies, and individual patients who prefer to have their blood checked frequently. The technologies used in this research project are Neural Network, Machine learning, Android mobile app Development, and Wireless networks. (Jayakody & Edirisinghe, 2020)
2.	**Authors:** Kavsaoǧlu, A. R., Polat, K., & Hariharan, M. **Title:** Non-Invasive Prediction Of Hemoglobin Level Using Machine Learning Techniques With The PPG Signal's Characteristics Features **Year: 2015**	*Photoplethysmography (PPG) signal (non-invasive) to measure hemoglobin levels in the blood*	In this study, photoplethysmography (PPG) signals were used (non-invasively) to measure hemoglobin concentration levels in the blood. Below, information is provided about the PPG signal. PPG is obtained through light that illuminates the relevant area of the body, which is then reflected or transmitted. To obtain PPG, a light source with a specific wavelength is placed on one side of the extension, for example, a finger, and a photodetector, which will capture the transmitted light correctly. The results obtained indicate that the combination of RFS and SVR can be reliably used in predicting hemoglobin levels as a non-invasive method based on PPG signals. (Kavsaoǧlu et al., 2015)
3.	**Authors:** S Y Veronica, M N Widyawati, and S Suryono **Title:** Sistem Berbasis Web Untuk Deteksi Dini Anemia Pada Ibu Hamil **Year: 2021**	*Informed Ruled-based Web*	This study uses a web-based rule-based information system to improve the effectiveness of anemia detection and monitoring in pregnant women. Pregnant women must fill out a biodata and medical form, then the information system displays several questions related to symptoms and they must select several questions about what they are experiencing by clicking on the appropriate

E-ISSN: **3047-2490**
Oktober 2025
Page: **086 – 091**

No	References	Artificial Intelligence	Results And Discussion
			questions and then clicking on the Diagnosis Expert menu to see the results. The research instrument is a web-based rule-based information system. Meanwhile, the material used is the Technology Acceptance Model (TAM) checklist to measure the effectiveness of the information system. Accurate early diagnosis is beneficial because it helps with prevention efforts, stimulates appropriate treatment, and refers patients to obstetricians for better care. The results of the web-based system and expert (midwife) validation of the 5 classifications of anemia show 100% accuracy. The accuracy of the system's diagnosis shows a good sensitivity score of 83% and specificity of 80%. The developed information system is capable of accurately detecting anemia in pregnant women by classifying types of anemia such as iron deficiency anemia, folate deficiency anemia, hemolytic anemia, aplastic anemia, and B12 deficiency anemia. (Veronica et al., 2021)
4.	**Authors:** M Abdul Hamid, Budhi Irawan, Muhammad Faris R **Title:** Perancangan Aplikasi Deteksi Dini Penyakit Anemia Menggunakan Sistem Pakar Dengan Metode Forward chaining Berbasis Android **Year: 2020**	*Forward Chaining*	This research uses the Forward Chaining method, which is a fact to obtain conclusions from those facts. This reasoning is based on existing facts (data driven). This method is the opposite of the Backward Chaining method, where this method is carried out by collecting existing facts to draw conclusions. In other words, the process begins with existing facts through a fact interface process (fact reasoning) towards a goal. This method also uses IF–THEN rules, where the premise (IF) leads to a conclusion (THEN). The process begins when the user provides input in the form of answers to symptoms of anemia that they are experiencing. After that, based on the answers provided by the user, grouping will be carried out in accordance with the expert data in the knowledge base, which will then be processed by the expert system using the Forward Chaining method. Next, the system will provide output in the form of a conclusion as to whether the user has anemia or not. (Hamid et al., 2020)
5.	**Authors:** Dithy M.D, V Krishna Priya **Title:** Anemia Selection in Pregnant Women by using Random prediction (Rp) Classification Algorithm **Year: 2019**	*The methodology consists of data pre-processing, improvement of the Median Vector Feature Selection (IMVFS) algorithm, and a new Random Prediction (RP) classification algorithm used to determine the type of anemia.*	The objective of this study was to develop a data mining process capable of selecting appropriate features and efficient classification to predict iron deficiency in pregnant women to support early detection of anemia. The results show that the proposed RandomPrediction (RP) classification with the feature selection method (IMVFS) clearly outperforms the previous ANN, Gausnominal, and VectNeighbour classification algorithms. (Dithy & Krishnapriya, 2019)
6.	**Authors:** Tatiparti Padma, Usha Kumari **Title:** Smart Non-Invasive Hemoglobin Measurement Using Portable Embedded Technology **Year: 2020**	*Non-invasive using PPG photoplethysmography at the fingertip with infrared LED*	Oxygen saturation measurement is referred to as PPG because it uses a photosensitive technique called Plethysmo Gram (PG), which is measured from an organ in the form of a volumetric procedure. This PPG is obtained with the help of a pulse oximeter sensor on the skin that shines light, sensitive to light other than measuring changes in light absorption due to blood movement or air volume in various parts of the body noninvasively at the site of microvascular tissue. Experimental Results The data generated is easily visualized by medical practitioners on their own Android phones using a simple application linked to ThingSpeak. Medical practitioners can instantly visualize Hb values through the real-time read API key provided. This product can be designed for an economical and commercial standalone system to perform a complete analysis, eliminating the invasive methods currently used. It reduces the risk of infection, extreme discomfort for certain patients, and blood loss. It can measure heart rate and oxygen saturation. (Padma & Kumari, 2020)
7.	**Authors:** Musli Yanto, Yuhandri dan Khairiazaz **Title:** Komparasi Metode Naive Bayes dan Certainty Factor untuk Mendiagnosa Penyakit Anemia **Year: 2020**	*Metode Naive Bayes dengan Certainty Factor (CF).*	From the results above, it can be seen that the expert system for diagnosing anemia, comparing the Naive Bayes method and the Certainty Factor method, shows that the Certainty Factor method is more accurate than the Naive Bayes method based on the calculations that have been performed. This is because there are rules that limit the calculations. Specifically, the Certainty Factor method requires specific values for the rules for all symptoms, while the Naive Bayes method only requires values of 0

E-ISSN: **3047-2490**
Oktober 2025
Page: **086 – 091**

No	References	Artificial Intelligence	Results And Discussion
			and 1 for all symptoms. (Yanto et al., 2020)
8.	**Authors:** Mario Hangga Digdo, Abdul Wakhid, Aris Wijayanti, Andik Adi Suryanto & Risky Eka Putri **Title:** Sistem Pakar Diagnosa Penyakit Pada Ibu Hamil Menggunakan Metode *Forward Chaining* Dan *Certainty Factor* **Year: 2022**	*Forward Chaining and Certainty Factor*	Connecting the relationship between symptoms and disease types, as well as certainty and uncertainty values. For the type of disease P01 is Anemia in pregnancy, P02 is Hemorrhoids, P03 is preeclampsia, P04 is Placenta previa, P05 is Diabetes mellitus (Gestational), and P06 is High blood pressure (Pregnancy Induced Hypertension). For the certainty value and the uncertainty value, these are the values given by experts for the type of symptoms based on the experts' knowledge. Dikdo, M. H., Wakhid, A., Wijayanti, A., Suryanto, A. A., & Putri, R. E. (2022).
9.	**Authors:** Rizki Muhammad Iqbal, Ir. Rita Magdalena, M.T., R Yunendah Nur Fu'adah, S.T., M.T**. Title:** *Support Vector Machine* Untuk Deteksi Anemia Secara Non- Invasif Melalui Konjungtiva Mata Berbasis Pengolahan Citra Digital **Year: 2018**	*Non-invasive method using digital imaging with Support Vector Machine (SVM)*	An alternative non-invasive method is to observe clinical conditions that can be seen based on paleness in the conjunctiva of the eyes, tongue, palms, and nails. This study aims to detect anemia based on paleness in the eye conjunctiva as a non-invasive method through digital images using Support Vector Machine (SVM) and using Red, Green, and Blue (RGB) images, Hue, Saturation, and Value (HSV) images, and Grayscale images with the *.png format, as well as extracting the mean, variance, skewness, kurtosis, and entropy values as features. The image classification method used is Support Vector Machine (SVM) using the MATLAB application. In an effort to achieve the best accuracy, the test variables studied used a combination of SVM parameters and kernels (RBF, linear, and polynomial kernels). Overall, using the SVM classification method for anemia detection, the highest accuracy of 72.9167% was successfully obtained using the RBF kernel with a computation time of 0.762 seconds and a training data size of 35 and test data size of 48. (Iqbal et al., 2018)
10.	**Authors:** Saldivar-Espinoza, B. dkk. **Title:** Portable system for the prediction of anemia based on the ocular conjunctiva using Artificial Intelligence. **Year: 2019**	*The portable system uses the ocular conjunctiva and a smartphone camera.*	The system used is images taken from a smartphone camera. The image is processed on the UPCH server to predict anemia, and the results are returned to the smartphone. Conjunctival extraction was performed through automatic segmentation using CNN, and then the R and G components of the Erythema Index (EI) were calculated. Finally, using these values and neural network regression, the prediction of Anemia is estimated. The research shows that our system is capable of predicting anemia with 77.58% sensitivity was achieved using images taken from popular smartphones and employing Artificial Intelligence techniques. In this way, the system used can be a fast, cost-effective, and globally useful screening tool for evaluating anemia, especially in rural areas where medical resources are limited. (Saldivar-Espinoza et al., 2019)

Anemia is a condition where the body lacks too much blood. The spread of this disease is widespread across all age groups. As for the symptoms of anemia, they include pale skin and eyes, hair loss, easy fatigue, frequent heart palpitations, shortness of breath, and pale nails. If not detected and treated quickly, anemia will damage the human immune system, disrupt the function of vital organs, and trigger various dangerous diseases. (Veronica et al., 2021)

Anemia affects 24.8% of the world's population and 43.5% of children. Current clinical methods primarily rely on blood extraction, which requires significant labor, is costly in terms of instrumentation, is a time-consuming procedure, and exposes individuals to bloodborne diseases. (Saldivar-Espinoza et al., 2019) Over the past few decades, various algorithms and devices have been designed to determine and diagnose anemia. That is, with the existence of expert systems or artificial intelligence (AI). Artificial Intelligence (AI) or artificial intelligence is known for the existence of an application called an expert system. An expert system is a computer application used to solve problems in the same way an expert would. The expert referred to here is a person who has special expertise that can solve problems that cannot be solved by laypeople. As technology has advanced, a technological system capable of adopting human processes and ways of thinking has also been developed, namely Artificial Intelligence technology. An expert system is a part of artificial intelligence that contains specific knowledge so that anyone can use it to solve various specific problems, in this case, disease-related issues. Dikdo, M. H., Wakhid, A., Wijayanti, A., Suryanto, A. A., & Putri, R. E. (2022).

Here are some methods related to the early diagnosis of anemia discussed in this literature review: A non-invasive device called "HemoSmart" that can help with the early diagnosis of anemia. The advantage of this method is that it is Android-based and the actions performed do not cause any wounds to the patient, thus

E-ISSN: 3047-2490
Oktober 2025
Page: 086 – 091

reducing the risk of infection. However, the accuracy and success rate of the diagnosis based on this artificial intelligence method are not mentioned. (Jayakody & Edirisinghe, 2020)

The second method is the photoplethysmography (PPG) signal method (non-invasive), with results showing that the combination of RFS and SVR can be reliably used in predicting hemoglobin levels as a non-invasive method based on the PPG signal. (Kavsaoɡlu et al., 2015) The third method is the Informed Ruled-based Web method, with accurate and early diagnosis being beneficial as it helps with prevention efforts, stimulates appropriate treatment, and referral to an obstetrician for further care. The results from the web-based system and expert validation (midwives) of 5 classifications of anemia showed 100% accuracy. The system's diagnostic accuracy showed good sensitivity scores of 83% and specificity of 80%. (Veronica et al., 2021)

Fourth is the forward chaining method, which involves analysis regarding the user's answer. Based on the user's answers, the system will group the information according to the expert data in the knowledge base, which will then be processed by the expert system using the Forward Chaining method. Next, the system will provide output in the form of a conclusion as to whether the user suffers from anemia or not. (Hamid et al., 2020)

Fifth, the Median Vector Feature Selection (IMVFS) algorithm and the Random Prediction (RP) classification algorithm. The results show that the proposed RandomPrediction (RP) classification with the feature selection method (IMVFS) clearly outperforms the previous ANN, Gaussian, and VectNeighbour classification algorithms. (Dithy & Krishnapriya, 2019) Sixth, the non-invasive method using PPG photoplethysmography at the fingertip with an infrared LED, research results show that medical personnel can instantly visualize Hb values. This product can be designed for economical and commercial standalone systems to perform complete analysis, eliminating the invasive methods currently used. With the advantage of reducing the risk of infection, extreme discomfort in certain patients, blood loss, and the ability to measure heart rate and oxygen saturation. (Padma & Kumari, 2020) Seventh, the Naive Bayes method with Certainty Factor (CF), the result

The comparison shows that the Certainty Factor method is more accurate than the Naive Bayes method based on the calculation tests already performed in diagnosing anemia. (Yanto et al., 2020) Next, we have the Forward Chaining and Certainty Factor methods. The research results are to connect the relationship between symptoms and disease types, as well as certainty and uncertainty values. For the type of disease P01 is Anemia in pregnancy, P02 is Hemorrhoids, P03 is preeclampsia, P04 is Placenta previa, P05 is Diabetes mellitus (Gestational), and P06 is High blood pressure (Pregnancy Induced Hypertension). For the certainty value and the uncertainty value, these are the values given by experts for the type of symptoms based on the experts' knowledge. Dikdo, M. H., Wakhid, A., Wijayanti, A., Suryanto, A. A., & Putri, R. E. (2022).

The next method is non-invasive through digital imaging using Support Vector Machine (SVM). Overall, using the SVM classification method for anemia detection, the highest accuracy of 72.9167% was successfully obtained using the RBF kernel with a computation time of 0.762 seconds and a training data size of 35 and test data size of 48. (Iqbal et al., 2018)

The final method in this literature review is to utilize Smartphone camera for taking images of the ocular conjunctiva, which are then processed with a portable system. The research showed that this system is capable of predicting anemia with 77.58% sensitivity using images taken from popular smartphones and employing artificial intelligence techniques in a portable system. (Saldivar-Espinoza et al., 2019) Based on this literature review, it was found that the benefits of an expert system include methods that can be used for faster, cheaper, globally applicable, and sufficiently popular early diagnosis of anemia, replacing doctors' visual examinations for anemia diagnosis. Such a system would be very useful in rural areas of developing countries, where medical resources are difficult to access.

4. CONCLUTION

Anemia is a disease that is frequently experienced by all segments of society in Indonesia. Anemia, if experienced by the body continuously, will have a negative impact on health. Therefore, it is hoped that the presence of artificial intelligence and expert systems can reduce the prevalence of anemia in Indonesia, including in remote areas, especially for early diagnosis of anemia. Based on all the literature that has been reviewed, the results obtained are that from Of all the artificial intelligence (AI) we have reviewed, we recommend 3 of them for use in the early diagnosis of anemia. The methods we recommend are based on their success rate in diagnosing anemia, namely the Informed Ruled-based Web method with 83% sensitivity accuracy, the portable ocular conjunctiva system with Smartphone assistance with 77.58% sensitivity, and Support Vector Machine (SVM) with the highest accuracy of 72.9167%. We can certainly recommend other methods as well, but with the requirement to prove their accuracy level so that the public and medical personnel can utilize this artificial intelligence in diagnosing anemia, considering the prevalence of anemia in Indonesia is still high among children, adolescents, pregnant women, and breastfeeding mothers. With the availability of an expert system for early anemia diagnosis, it is hoped that further research will be conducted on the success rate and accuracy of each method used in the literature review. So that the public and medical personnel can utilize the beneficial

developments in artificial intelligence to reduce the prevalence of anemia in Indonesia. However, these methods are only suitable as aids for early anemia detection in the community. Therefore, deeper and more complex studies are needed to make these methods useful tools for doctors in detecting anemia. It is hoped that testing these artificial intelligence methods can benefit the entire community, especially those in remote areas of Indonesia who have difficulty accessing healthcare services.

REFERENCES

Dithy, M. D., & Krishnapriya, V. (2019). Anemia selection in pregnant women by using random prediction (Rp) classification algorithm. *International Journal of Recent Technology and Engineering*, *8*(2), 2623–2630. https://doi.org/10.35940/ijrte.B3016.0 78219

Halim, W., & Mudjihartono, P. (2022). *Kecerdasan Buatan dalam Teknologi Kedokteran : Survey Paper*. *2*(1).

Hamid, M. A., Irawan, B., & Faris, M. (2020). Perancangan aplikasi deteksi dini penyakit anemia menggunakan sistem pakar dengan metode forward chaining berbasis android. *E- Proceeding of Engineering*, *7*(1), 1–7.

Iqbal, R. M., Magdalena, I. R., & Nur, R. Y. (2018). *Support Vector Machine Untuk Deteksi Anemia Secara Non- Invasif Melalui Konjungtiva Mata Berbasis Pengolahan Citra Digital Support Vector Machine for Non- Invasive Anemia Detection Through Conjunctiva on Eyes Based on Digital Image Processing*. *5*(3), 5586–5593.

Jayakody, J. A. D. C. A., & Edirisinghe, E. A. G. A. (2020). HemoSmart: A non- invasive, machine learning based device and mobile app for anemia detection. *IEEE Region 10 Annual International Conference, Proceedings/TENCON*, *2020-Novem*, 1401–1406. https://doi.org/10.1109/TENCON5079 3.2020.9293903

Kavsaoğlu, A. R., Polat, K., & Hariharan, M. (2015). Non-invasive prediction of hemoglobin level using machine learning techniques with the PPG signal's characteristics features. *Applied Soft Computing Journal*, *37*, 983–991. https://doi.org/10.1016/j.asoc.2015.04.008

Padma, T., & Kumari, U. (2020). Smart Non-Invasive Hemoglobin Measurement Using Portable Embedded Technology. *International Journal of Online and Biomedical Engineering*, *16*(15), 106–120. https://doi.org/10.3991/ijoe.v16i15.18 949

Saldivar-Espinoza, B., Núñez- Fernández, D., Porras-Barrientos, F., Alva-Mantari, A., Leslie, L. S., & Zimic, M. (2019). *Portable system for the prediction of anemia based on the ocular conjunctiva using Artificial Intelligence*. *NeurIPS*, 1–3. http://arxiv.org/abs/1910.12399

Sastypratiwi, H., & Nyoto, R. D. (2020). Analisis Data Artikel Sistem Pakar Menggunakan Metode Systematic Review. *Jurnal Edukasi Dan Penelitian Informatika (JEPIN)*, *6*(2), 250. https://doi.org/10.26418/jp.v6i2.40914

Trolice, M. P., Curchoe, C., & Quaas, A. M. (2021). Artificial intelligence— the future is now. *Journal of Assisted Reproduction and Genetics*, *38*(7), 1607–1612. https://doi.org/10.1007/s10815-021- 02272-4

Veronica, S. Y., Widyawati, M. N., & Suryono, S. (2021). Web-based rule- based system for arly detection of anemia among pregnant mothers. *IOP Conference Series: Materials Science and Engineering*, *1108*(1), 012021. https://doi.org/10.1088/1757-899x/1108/1/012021

Yanti, F. D., Olii, N., Tompunuh, M. M., Z, S. N., Abdul, N. A., & Luawo, H. P. (2022). *MENCEGAH ANEMIA PADA REMAJA PUTRI*. *6*(2), 1–3.

Yanto, M., Khairiazaz, Y., & Kunci, K. (2020). *Komparasi Metode Naive Bayes dan Certainty Factor untuk Mendiagnosa Penyakit Anemia Pendahuluan Metode Penelitian*. *19*, 1–8.

Dikdo, M. H.., Wakhid, A., Wijayanti, A., Suryanto, A. A., & Putri, R. E. (2022). Sistem Pakar Diagnosa Penyakit Pada Ibu Hamil Menggunakan Metode Forward Chaining Dan Certainty Factor. *STAINS (SEMINAR NASIONAL TEKNOLOGI &Amp; SAINS)*, *1*(1), 125–131. Retrieved from https://proceeding.unpkediri.ac.id/inde x.php/stains/article/view/1517