High-Risk Assessment System for Maternal Mortality Rate with the Analytic Hierarchy Process Method

Dadang Heksaputra
Universitas Alma Ata: Information System
Faculty of Computer
Yogyakarta, Indonesia
dadang@almaata.ac.id

M.J.U Haris Bahrudin
Universitas Alma Ata: Information System
Faculty of Computer
Yogyakarta, Indonesia
jokoharis@almaata.ac.id

Fatma Siti Fatimah
Universitas Alma Ata: Hospital administration
Faculty of Health Science
Yogyakarta, Indonesia
fatmasitifatimah@almaata.ac.id

Abstract— **Bantul's 2012 MMR data reached 50 per 100,000 live births. The prevalence of chronic energy deficiency (KEK) is 13.86%, the majority of BUMIL anemia was 28.67%, the incidence of LBW is 3.97%, the IMR is 6.4 per 1000 based on data from the Bantul Health Office, and the prevalence of short & concise children under five still reaches 30 %. This study calculates the high risk of maternal mortality using the Analytic Hierarchy Process method. The method functions to solve a complicated unstructured situation into several components in a hierarchical arrangement by giving subjective values about each variable's relative importance and determining which variables have the most priority. High to influence the outcome in the situation. The results showed that applying the Analytic Hierarchy Process method can be used to the high-risk assessment system for maternal mortality.**

Keywords— system; assessment; risk; mortality; pregnant mother

I. INTRODUCTION

Bantul's 2012 MMR data reached 50 per 100,000 live births. The prevalence of chronic energy deficiency (KEK) was 13.86%, the majority of BUMIL anemia is 28.67%, the incidence of LBW is 3.97%, the IMR is 6.4 per 1000 based on data from the Bantul Health Office, and the prevalence of short & concise children under five still reaches 30 %. Suppose the Nutrition-MCH problem is seen by sub-district. In that case, the three sub-districts in Bantul Regency with the most severe nutrition-MCH problems are Pudong, Sedayu, and Kasihan Districts, respectively [1] [2] [3]. The Fuzzy Multiple Criteria Decision-Making method is a method proposed by researchers. The technique is expected to provide the best alternative from a set of other options based on the criteria indicators [3] [4]. In this case, population data, in this case, the distribution of maternal and child mortality rates. Data visualization using the concept of geographic information systems about the distribution in the research area [5] [6]. Information is displayed on the map. Priyanti et al in 2013 reviewed the data information system of the Bogor villagers [6]. This study calculates the high risk of maternal mortality using the Analytic Hierarchy Process method.

II. LITERATURE REVIEW

The method serves to solve a complicated unstructured situation into several components in a hierarchical arrangement by giving subjective values about each variable's relative importance and determining which variables have the highest priority to influence the outcome of the situation. Conduct a consistency test of the comparison between elements found at each hierarchical level. To improve monitoring of maternal and child health, puskesmas can benefit from operational health assistance [7] [8]. Another effort is to educate on understanding and knowledge using the KIA book [9] [10] [11] [12] [13] [14] [15] [16]. Family support is an essential factor in understanding education [17] [18] [19] [20] [21]. Another factor in nutritional intake efforts, including energy and protein, can prevent malnutrition so that mothers' and children's health is maintained [22] [23]. Exclusive breastfeeding is needed so that children's health could be maintained [24] [25]. The main success factors in implementing a reward and punishment system, and community empowerment [26]. The class effort for pregnant women was carried out to monitor the health of mothers and children, but it was not by the implementation guidelines [27] [28] [29] [30] [31]. Speculative applications have been developed for monitoring the growth and development of mothers and children, but they could not accommodate the massive needs [32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45]. Applications with decision support systems had been developed using artificial intelligence [46] [47] [48]. A good performance culture

needed to be built starting from attitudes, paramedical services, and motivation [49].

III. METHOD

The process of the fuzzy variable set and analytic hierarchy is carried out based on decision evaluation [50]. We developed a pairwise comparison matrix with alternatives in table 2 based on the priority scale. The priority scale can be seen in table 1.

TABLE I.   WEIGHTING CRITERIA

| No | Explanation | |
	Values	Definition
1	9	Absolute Very Important
2	7	Approaching is very important
3	5	More important
4	3	A little bit more important
5	1	Just as Important
6	0.33	A little less important
7	0.2	Not too important
8	0.14	Approaching Not Important
9	0.11	Absolute Not Important

Paired matrices often represent criteria and alternatives. The matrix is used as a comparison scale as a scale measure that expresses the intensity of importance. Processing stages are shown in Figure 1.
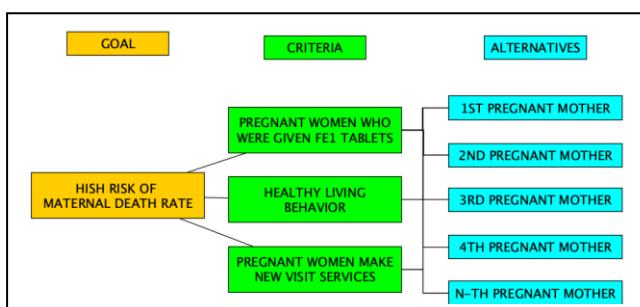
Figure 1 Decision Model Diagram

The initial stage by defining the problem and setting goals [51]. If AHP is used to select alternatives or compile alternative priorities [52], At this stage, an alternative is developed. The second stage is by arranging problems into a hierarchy so that complex issues can be viewed from a detailed and measurable side [53]. The third stage is prioritizing each problem element in the hierarchy. This process generates the weight or contribution of components to the achievement of goals so that the details with the highest weight have priority handling [54]. Priority is generated from a pairwise comparison matrix between all elements at the same hierarchical level [55].

TABLE II.   VARIABLES TYPES

| No | Explanation | |
	Criteria	Definition
1	First	pregnant women who were given Fe1 tablets
2	Second	healthy living behavior
3	Third	pregnant women make new visit services

The stages present the process of calculating the weight of the factors that affect the price index of the analytical hierarchy process construction [56]. We calculate the synthetic comparison matrix using the formula (1) (2) (3).

$$\widetilde{b_{ij}} = (\widetilde{b_{ij}^1} \otimes \widetilde{b_{ij}^2} \otimes \widetilde{b_{ij}^3}) \dots \dots \dots \dots \dots (1)$$

Compilation of formulas for calculating fuzzy weights of factors affecting the construction.

$$\widetilde{q_i} = (\widetilde{b_{i1}} \otimes \widetilde{b_{i2}} \otimes \widetilde{b_{i3}})^{1/n} \dots \dots \dots \dots (2)$$

The weight factor affects the construction with the 3rd formula.

$$\widetilde{w_i} = \widetilde{q_i} \otimes (\widetilde{q_1} \oplus \widetilde{q_2} \oplus \widetilde{q_3})^{-1} \dots \dots \dots (3)$$

w is represented as a value in the fuzzy environment.

IV. RESULTS AND DISCUSSION

The results showed that applying the Analytic Hierarchy Process method could be used to the high-risk assessment system for maternal mortality. The weighting of the variables was shown in table I. Table II established the assessment criteria. There were three assessment criteria: pregnant women who were given Fe1 tablets, healthy living behavior, and pregnant women who make new visit services. The calculation of the system assessment started by determining the type of work. The design for selecting the kind of work can be seen in Figure 2.
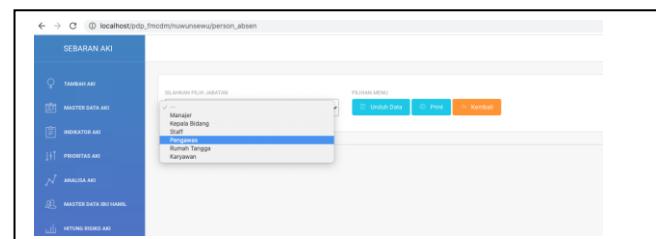
Figure 2 Decisions based on the type of work

After the type of work was obtained and selected by the administrator user, the administrator will get

several views of the calculation in the next step. The analysis includes the value of each criterion on the indicator. The calculation result display design is shown in Figure 3.
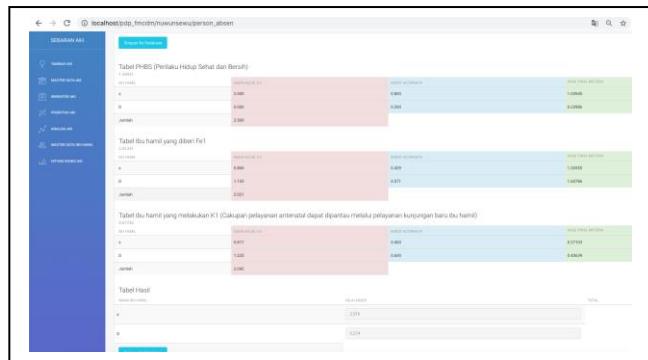

Figure 3 Display Design of Calculation Results for Each Alternative

The detail of the calculation started with the assessment of each criterion for each pregnant woman. The calculation design display is shown in Figure 4.


Figure 4 Assessment Design for Each Alternative for each Pregnant Mother

The value of the assessment result was used in the metric product of equation (3). Previously, weighting was carried out first by selecting the priority scale shown in Table 1, using equation (1). The next step is to multiply the inverse of the weight metric by equation (2). The ranking results are shown in Figure 3. The equation's manual calculation could be assumed that the weighting of the priority scale is obtained with the value of pregnant women who were given Fe1 tablets of 2.81341, healthy living behavior of 1.29931, and pregnant women make new visit services of 0.67742. The results of the weighting calculation were obtained from the priority scale in the comparison table 1. After the priority scale is formed, it would be used to compile the matrix in equation (2) of the weighted gain. The

final result of the calculation was the ranking of weights from the multiplication of equation effects (3).

V. CONCLUSIONS

The Analytic Hierarchy Process method can be used as an alternative recommendation tool for a highrisk assessment system for maternal mortality.

ACKNOWLEDGMENT

REFERENCES

[1] R. Kemenkes, *Profil Kesehatan Indonesia Tahun 2013*, vol. 14, no. 8. 2014.

[2] Kementerian Kesehatan RI, "Peraturan Menteri Kesehatan No. 741 tentang Standar Pelayanan Minimal Bidang Kesehatan di Kabupaten/Kota." Mentri Kesehatan, Jakarta, p. 11, 2008.

[3] C. Çetinkaya, E. Özceylan, M. Erbaş, and M. Kabak, "GIS-based fuzzy MCDA approach for siting refugee camp: A case study for southeastern Turkey," *Int. J. Disaster Risk Reduct.*, vol. 18, pp. 218–231, 2016, doi: 10.1016/j.ijdrr.2016.07.004.

[4] L. Suganthi, S. Iniyan, and A. A. Samuel, "Applications of fuzzy logic in renewable energy systems - A review," *Renew. Sustain. Energy Rev.*, vol. 48, pp. 585–607, 2015, doi: 10.1016/j.rser.2015.04.037.

[5] I. Dharmawan Setiadi, I. Piarsa, and N. Ika Marini Mandenni, "Sistem Informasi Geografis Pemetaan Tingkat Pertumbuhan Penduduk Berbasis Web," *Merpati*, vol. 3, no. 3, pp. 180–189, 2015.

[6] D. Priyanti and S. Irani, "Sistem Informasi Data Penduduk Pada Desa Bogoharjo Kecamatan Ngadirojo Kabupaten Pacitan," *IJNS - Indones. J. Netw. Secur.*, vol. 2, no. 4, p. 56, 2013, [Online]. Available: ijns.org.

[7] A. Aridewi, M. I. Kartasurya, and A. Sriatmi, "Analisis Pemanfaatan Bantuan Operasional Kesehatan dalam Upaya Peningkatan Kesehatan Ibu dan Anak di Puskesmas Wilayah Kerja Dinas Kesehatan Kabupaten Kudus," *J. Manaj. Kesehat. Indones.*, vol. 01, no. 01, pp. 32–40, 2013.

[8] A. Prayogo, A. Suryoputro, and A. Sriatmi, "Analisis Efektivitas Program Kesehatan Ibu Yang Didanai Bantuan Operasional Kesehatan Di Puskesmas Bandarharjo Kota Semarang," *J. Kesehat. Masy.*, vol. 5, no. 1, pp. 8–13, 2017.

[9] E. Kurniawati and A. Sulistyawati, "Pemanfaatan Buku KIA Oleh Ibu Hamil Trimester III," *J. Ilmu Kebidanan*, vol. 1, no. 3, pp. 123–132, 2013.

[10] S. Nurhayati, C. Sistiarani, and E. Dardjito, "Studi Deskriptif Peningkatan Kualitas Penggunaan Buku KIA pada Ibu Balita Di Desa Kalibagor," *J. Kesmasindo*, vol. 7, no. 1, pp. 54–62, 2014.

[11] Y. P. Rahayu, Mahpolah, and F. M. Panjaitan, "Hubungan Pengetahuan Dan Sikap Ibu Hamil Tentang Tanda Bahaya Kehamilan Terhadap Pemanfaatan Buku Kia Di Upt. Puskesmas Martapura," *Din. Kesehat.*, vol. 6, no. 1, pp. 146–152, 2015.

[12] L. Kurniasari, "BUKU KIA DAN PEMANFAATAN UNTUK PENINGKATAN KESEHATAN IBU DAN ANAK," *Kesmas Wigama*, vol. 3, no. 1, pp. 9–18, 2017.

[13] R. Hanum and M. E. Safitri, "HUBUNGAN PENGETAHUAN DAN SIKAP IBU HAMIL TENTANG

PEMANFAATAN BUKU KIA DI PUSKESMAS NAMU UKUR," *J. Bidan Komunitas*, vol. 1, no. 3, pp. 152–160, 2018.

[14] I. B. Wijayanti, D. E. Widyastuti, and E. Hapsari, "Hubungan Pengetahuan Dan Sikap Ibu Tentang Buku Kia(Kesehatan Ibu Dan Anak) Dengan Perilaku Membawa Buku Kia Pada Kegiatan Posyandu Di Wilayah Puskesmas Gambirsari," *JKM (Jurnal Kesehat. Masyarakat) Cendekia Utama*, vol. 7, no. 1, pp. 39–48, 2019, doi: 10.31596/jkm.v6i2.295.

[15] K. Maharani, Qomariyah, and N. Rahimah, "Determinan Pemanfaatan Buku Kesehatan Ibu Dan Anak (Kia) Pada Ibu Hamil Dipuskesmas Karangayu Kota Semarang," *J. Kesehat. STIKES Telogorejo*, vol. 9, no. 2, pp. 69–75, 2019, [Online]. Available: http://182.253.197.100/e-journal/index.php/jikk/article/view/799.

[16] N. Purbowati, D. N. Sari, and S. Masitoh, "Effectiveness of Counseling Using MCH Handbook 2017ed to The Knowledge and Attitudes of Mothers About Monitoring Toddler Growth," *J. Ilmu Dan Teknol. Kesehat.*, vol. 7, no. 2, pp. 162–171, 2020.

[17] D. Puspitasari and S. Nurunniyah, "Dukungan Keluarga dalam Keikutsertaan KB pada Pasangan Usia Subur di Desa Argomulyo Sedayu Bantul Yogyakarta," *J. Ners dan Kebidanan Indones.*, vol. 2, no. 3, pp. 93–98, 2014, doi: 10.21927/jnki.v2i3.102.

[18] A. Fitriyah, N. Purbowati, and W. Follona, "Faktor-Faktor yang Berhubungan Dengan Kunjungan Ibu Dengan Balita ke Posyandu," *SEAJOM Southeast Asia J. Midwifery*, vol. 5, no. 2, pp. 79–83, 2019, doi: 10.36749/seajom.v5i2.73.

[19] V. Raraningrum and R. D. Yunita, "Amankan Ibu dan Anak Bersama Akademisi dengan Model Pendampingan Continue of Care di Wilayah Puskesmas Kedungrejo dan Puskesmas Purwoharjo," *War. Pengabdi.*, vol. 13, no. 1, pp. 7–12, 2019, doi: 10.19184/wrtp.v13i1.9271.

[20] I. Nurhidayah, N. O. Hidayati, and A. Nuraeni, "Revitalisasi Posyandu melalui Pemberdayaan Kader Kesehatan," *Media Karya Kesehat.*, vol. 2, no. 2, pp. 145–157, 2019, doi: 10.24198/mkk.v2i2.22703.

[21] H. S. Lubis and D. N. Santi, "Cadre posyandu empowerment and apparatus village in monitoring status nutrition, food provision of additional pregnant women and children to prevent stunting," *ABDIMAS Talent. J. Pengabdi. Kpd. Masy.*, vol. 5, no. 1, pp. 33–39, 2020, doi: 10.32734/abdimastalenta.v5i1.4022.

[22] S. Susetyowati, H. Hadi, A. H. Asdie, and M. Hakimi, "Penerapan algoritma proses asuhan gizi terstandar berbasis skrining gizi," *J. Gizi Klin. Indones.*, vol. 11, no. 1, p. 20, 2014, doi: 10.22146/ijcn.18880.

[23] L. G. Kumendong, R. Kundre, and Y. Bataha, "HUBUNGAN FREKUENSI KUNJUNGAN ANTENATAL CARE(ANC) DAN STATUS GIZI IBU HAMIL TRIMESTER III DENGAN BERAT BADANLAHIR (BBL) BAYI DI RSU PANCARANKASIHGMIM MANADO TAHUN 2015," *ejournal Keperawatan (e-Kp)*, vol. 3, no. 2, pp. 1–7, 2015.

[24] S. Nurunniyah and D. T. Sugesti, "Pengasuh berhubungan dengan keberhasilan pemberian ASI eksklusif pada baduta di Kecamatan Sedayu," *J. GIZI DAN Diet. Indones.*, vol. 4, no. 1, pp. 1–7, 2016, doi: 10.21927/ijnd.2016.4(1).1-7.

[25] K. A. Susiloretni, H. Hadi, M. M. Blakstad, E. R. Smith, and A. H. Shankar, "Does exclusive breastfeeding relate to the longer duration of breastfeeding? A prospective cohort study," *Midwifery*, vol. 69, pp. 163–171, 2019, doi: 10.1016/j.midw.2018.11.008.

[26] Rustika and Raflizar, "REVOLUSI KESEHATAN IBU DAN ANAK DALAM MENINGKATKAN PERSALINAN OLEH TENAGA KESEHATAN DI FASILITAS KESEHATAN KABUPATEN KUPANG," *J. Ekol. Kesehat.*, vol. 14, no. 1, pp. 81–88, 2015.

[27] A. Nurdiyan, Yulizawati, L. E. S. Bustami, Fitrayeni, and D. Iryani, "Analisis Sistem Pelaksanaan Kelas Ibu Hamil di Puskesmas Malalak dan Biaro Kabupaten Agam," *J. Kesehat. Andalas*, vol. 4, no. 1, pp. 45–54, 2016, doi: 10.25077/jka.v4i1.173.

[28] A. Y. Wuriningsih et al., "Pendampingan Ibu Hamil Melalui Program One Student One Client (Osoc) Di Wilayah Kerja Puskesmas Genuk Semarang," *Pros. Semin. Nas. Publ. Hasil-Hasil Penelit. dan Pengabdi. Masy.*, pp. 720–729, 2017.

[29] E. Nurlaela, W. Ersila, N. I. Kusuma, M. Pekajangan, and S. M. Pekajangan, "Hubungan Pelaksanaan Pencatatan dengan Hasil Pencatatan Kohort Ibu Emi," *J. Ilm. Kesehat.*, vol. 10, no. 2, pp. 216–221, 2017.

[30] A. N. Fauziah and S. Maesaroh, "Gambaran Kesehatan Ibu Dan Anak Dengan Pendekatan Keluarga Di Rw 12 Kalurahan Mojosongo Surakarta," *Avicenna J. Heal. Res.*, vol. 2, no. 1, pp. 95–105, 2019, doi: 10.36419/avicenna.v2i1.264.

[31] N. Hafifah and Z. Abidin, "Peran Posyandu dalam Meningkatkan Kualitas Kesehatan Ibu dan Anak di Desa Sukawening, Kabupaten Bogor," *J. Pus. Inov. Masy.*, vol. 2, no. 5, pp. 893–900, 2020.

[32] S. Hernanda and W. Yustanti, "Rancang Bangun Aplikasi Monitoring Tumbuh Kembang Balita Berbasis Android," *J. Manaj. Inform.*, vol. 6, no. 1, pp. 1–6, 2016.

[33] A. Pratama, Sulistiowati, and Y. M. Maulana, "Rancang Bangun Sistem Informasi Pemantauan Dan Evaluasi Pelayanan Kesehatan Dasar Pada Ibu Berdasarkan SPM," *JSIKA*, vol. 5, no. 10, pp. 1–10, 2016.

[34] I. R. Sari and F. Nugraha, "SISTEM INFORMASI PENCATATAN DAN PELAPORAN PUSKESMAS PROGRAM KESEHATAN IBU DAN ANAK PADA DINAS KESEHATAN KABUPATEN KUDUS," *J. SIMETRIS*, vol. 7, no. 1, pp. 251–256, 2016.

[35] N. Windiarto, N. Saurina, and N. I. Prasetya, "Aplikasi Monitoring Berat Badan Ibu Hamil," *MelekIT*, vol. 2, no. 1, pp. 9–16, 2016.

[36] M. Kamisutara and I. P. Artaya, "Aplikasi Early Warning Kesehatan Ibu Hamil Guna Percepatan Penurunan Angka Kematian Ibu Dan Bayi Berbasis Web," *Semin. Nas. Sains dan Teknol. Terap. V*, pp. 71–76, 2017.

[37] A. Supriyanto and B. Hartono, "Peran teknologi informasi bagi kader posyandu dalam kegiatan pendataan KIA," *Semin. Nas. Vokasi dan Teknol.*, pp. 360–365, 2017, [Online]. Available: http://eproceeding.undiksha.ac.id/index.php/semnasvoktek/article/view/706.

[38] L. Rusdiana and H. Setiawan, "Perancangan Aplikasi Monitoring Kesehatan Ibu Hamil Berbasis Mobile Android," *Sistemasi*, vol. 7, no. 3, pp. 197–203, 2018, doi: 10.32520/stmsi.v8i1.391.

[39] D. Zuhri, R. A. Siswanto, and J. Utama, "PERANCANGAN USER INTERFACE APLIKASI MOBILE PEMANTAU KELUHAN KESEHATAN PADA ANAK," *Progr. Stud. Desain Komun. Vis. Fak. Ind. Kreat. Univ. Telkom*, pp. 1–9, 2018.

[40] I. G. Pratiwi and D. A. Restanty, "Penerapan Aplikasi Berbasis Android 'Status Gizi Balita Terhadap Pengetahuan Ibu Dalam Pemantauan Status Gizi Anak Usia 12-24 Bulan,'" *JKAKJ*, vol. 2, no. 1, pp. 8–14, 2018.

[41] G. Wicahyono, A. Setyanto, and S. Raharjo, "Aplikasi Mobile Smart Birth Untuk Monitoring Ibu Hamil," *J. IT CIDA*, vol. 5, no. 1, pp. 53–60, 2019.

[42] Z. Imaduddin, H. Saptono, S. T. Fauziah, H. A. Tawakal, and D. Hamzah, "Aplikasi Monitoring Perkembangan Janin

(Antenatal Care) Dengan Metode Scrum Berbasis Perangkat Mobile," *J. Teknol. Terpadu*, vol. 5, no. 1, pp. 34–41, 2019.

[43] Julizal, Lukman, and I. Sunoto, "Rancang Bangun Aplikasi Sistem Pengolahan Data," *STRING (Satuan Tulisan Ris. dan Inov. Teknol.*, vol. 4, no. 1, pp. 18–24, 2019.

[44] D. H. Kusuma, M. N. Shodiq, D. Yusuf, and L. Saadah, "Si-Bidan: Sistem Informasi Kesehatan Ibu dan Anak," *INTENSIF J. Ilm. Penelit. dan Penerapan Teknol. Sist. Inf.*, vol. 3, no. 1, p. 43, 2019, doi: 10.29407/intensif.v3i1.12508.

[45] A. Mustakim, Agussalim, and E. M. Safitri, "PENGEMBANGAN APLIKASI MONITORING PEMERIKSAAN KOHORT IBU HAMIL BERBASIS ANDROID," *Semin. SANTIKA*, pp. 165–170, 2019.

[46] R. D. Sanitasari, D. Andreswari, and E. P. Purwandari, "SISTEM MONITORING TUMBUH KEMBANG ANAK USIA 0-5 TAHUN BERBASIS ANDROID (Studi Kasus : PUSKESMAS Beringin Raya Kota Bengkulu)," *J. Rekursif*, vol. 5, no. 1, pp. 1–10, 2017.

[47] T. M. Kadarina, "Portable Medical Device untuk Aplikasi Pelayanan Kesehatan Ibu dan Anak Berbasis IoT," *J. Teknol. Elektro*, vol. 9, no. 2, pp. 101–108, 2018.

[48] A. H. Jatmika, R. Afwani, and N. Agitha, "Perancangan Software As A Service (SAAS) untuk Sistem Pelayanan Kesehatan Ibu dan Anak (PKIA) pada Puskesmas Se-Kota Mataram Berbasis Cloud Computing," *J. Teknol. Inf. dan Ilmu Komput.*, vol. 6, no. 5, pp. 485–490, 2019, doi: 10.25126/jtiik.2019651589.

[49] F. Kusyanti, "FAKTOR MOTIVASI DAN SIKAP YANG BERHUBUNGAN DENGAN KINERJA BIDAN DALAM PEMANTAUAN PENCATATAN PELAPORAN POSYANDU DI WILAYAH KERJA DINAS KESEHATAN KABUPATEN MAGELANG TAHUN 2014," *J. Med. Respati*, vol. 12, no. 3, pp. 31–36, 2017.

[50] M. Rashidi, M. Ghodrat, B. Samali, B. Kendall, and C. Zhang, "Remedial modelling of steel bridges through application of analytical hierarchy process (AHP)," *Appl. Sci.*, vol. 7, no. 2, pp. 1–20, 2017, doi: 10.3390/app7020168.

[51] M. Vojtek and J. Vojteková, "Flood susceptibility mapping on a national scale in Slovakia using the analytical hierarchy process," *Water (Switzerland)*, vol. 11, no. 364, 2019, doi: 10.3390/w11020364.

[52] S. Abadi *et al.*, "Implementation of fuzzy analytical hierarchy process on notebook selection," *Int. J. Eng. Technol.*, vol. 7, no. 2.27, pp. 238–243, 2018, doi: 10.14419/ijet.v7i2.27.12047.

[53] E. Purba and H. T. Sihotang, "Decision Support System For Prospective Recipients Of The Healthy Indonesia Card (Kis) In The Village Of Bah Sidua Dua With The Analytical Hierarchy Process (AHP) Method," *J. Mantik*, vol. 3, no. 3, pp. 82–90, 2019.

[54] S. A. A. Shah, Y. A. Solangi, and M. Ikram, "Analysis of barriers to the adoption of cleaner energy technologies in Pakistan using Modified Delphi and Fuzzy Analytical Hierarchy Process," *J. Clean. Prod.*, vol. 235, pp. 1037–1050, 2019, doi: 10.1016/j.jclepro.2019.07.020.

[55] M. Azizkhani, A. Vakili, Y. Noorollahi, and F. Naseri, "Potential survey of photovoltaic power plants using Analytical Hierarchy Process (AHP) method in Iran," *Renew. Sustain. Energy Rev.*, vol. 75, no. December, pp. 1198–1206, 2017, doi: 10.1016/j.rser.2016.11.103.

[56] P. T. Nguyen and Q. Le Hoang Thuy To Nguyen, "Critical factors affecting construction price index: An integrated fuzzy logic and analytical hierarchy process," *J. Asian Financ. Econ. Bus.*, vol. 7, no. 8, pp. 197–204, 2020, doi: 10.13106/JAFEB.2020.VOL7.NO8.197.