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Content validity and inter-rater reliability of procedural skill checklists used in the online OSCE scoring management system

Ferika Indarwati, Yanuar Primanda, Fahni Haris, Resti Yulianti Sutrisno

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Vitamin D and cathelicidin assessment in children with pneumonia

Fatimah Arief, Retno Asih Setyoningrum, Roedi Irawan, Dominicus Husada, I Ketut Alit Utamayasa, Hartono Kahar

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The Efficacy of Blood Flow Restriction Training for Grip Strength and Disability in Lateral Epicondylitis

Gede Parta Kinandana, Anak Ayu Nyoman Trisna Narta Dewi, I Made Niko Winaya, Ni Komang Ayu Juni Antari, Ari Wibawa, I Putu Gde Surya Adhitya

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The Risk Factor Associated with Stress Urinary Incontinence (SUI) Severity: a Cross-Sectional Multi-centered Study

Surahman Hakim, Budi Iman Santoso, Harrina Erlianti Rahardjo, Siti Setiati, Widjajalaksmi Kusumaningsih, Joedo Prihartono

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Anak Agung Ngurah Krisna Putra, Irwanto, Reny I'tishom, Bagus Setyoboedi, Muhammad R. D. Mustakim

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Knowledge, Attitude and Practice Related to Organ Donation Among Healthcare Workers at University of Kebangsaan Malaysia Medical Centre (UKMMC)

Wan Haslina Wan Abdul Halim, Norshamsiah Mohd Din, Viknesh Kuppusamy, Sinaran Samsu Nurul Ayuni Syafiqah Mat Ropi, Thivyasri Kanapathy, Nur Najihah Mohd Shaiful Bahri

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Validity and reliability of the Indonesian version of QOLIE-10

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The clinicopathological characteristics of borderline ovarian tumors at Dr. Soetomo Hospital, Surabaya: a single center study

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CYP1A1 rs464903 increased the risk of undifferentiated type nasopharyngeal carcinoma among the Balinese population

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The The association of Hs-Troponin I with cardiac dysfunction and structural changes in chronic heart failure with reduced ejection fraction patients

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The effectiveness of Barbagli technique compared to Kulkarni technique for urethral strictures: a systematic review and meta-analysis

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Effects of modified hybrid resistance training on concentric quadriceps femoris peak torque and eccentric hamstring peak torque in untrained healthy subjects

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Association between serum homocysteine levels and the frequency of epileps related cognitive dysfunction: a cross sectional study in patients with epileps in Mataram, Indonesia

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Norepinephrine modified the interaction between Escherichia coli and levofloxacin, potentially affecting clinical outcomes and increasing the risk of bacterial colonization

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Development of social skill training design for preschool in social distancing pandemic COVID-19

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Levels of anxiety and depression of students and responses to online learning methods during the COVID-19 pandemic

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Clonidine premedication was better in preventing hemodynamic response changes post laryngoscopy and endotracheal intubation compared to fentanyl premedication

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Diani Kartini, Sonar Soni Panigoro, Islam Akbar Alam, Alban Willian Dien, Dewi Sumaryani Soemarko, Tantri Hellyanti, Jessica Dewati Wardhana, Kevin Varian Marcevianto

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Profile of matrix metalloproteinase activity, markers of collagen and elastin degradation and remodeling during pregnancy, delivery, and puerperium in pelvic organ prolapse 3 months after childbirth

Tyas Priyatini, Budi Iman Santoso, Trika Irianta, Herqutanto, Nuryati Siregar, Alida Harahap, Mohamad Sadikin

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Placental apoptotic index on COVID-19 and non-COVID-19 cases: a cross sectional study

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Effect of Spiritual Emotional Model (SPIEM) dhikr on cortisol and IgG levels of drug abusers during rehabilitation programs

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Effects of Tissue Flap on Expression of Vascular Endothelial Growth Factor-C (VEGF-C) as a Marker of Improved Inguinal Lymphatic Circulation on Dissected Mice

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Animal model of contusion compression spinal cord injury by Yasargil aneurysm clip

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Profile of female blood donors in the blood transfusion units of Dr. Sardjito Central General Hospital Yogyakarta

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Comparison of trauma scoring system in predicting post-surgical fixation outcomes of traumatic rib fracture

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Correlation between age, the clinical status of patients, operator characteristics, and surgical landmarks with the incidence of tracheotomy complications

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The potential role of MMP-9 and VEGF-C as predictors of lymph node involvement in papillary thyroid carcinoma

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Correlation between platelet distribution width and mean platelet volume with the stage of hepatocellular carcinoma based on Barcelona Clinical Liver Cancer criteria

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Factors related to mortality in geriatric patients after elective surgery: a retrospective cohort study

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The relationship between nutritional status before chemotherapy with nutritional status after chemotherapy in locoregionally advanced nasopharyngeal carcinoma patients

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Bacteriocin potency test of lactic acid bacteria (LAB) isolated from rumen of Bali cattle against low pH and bile salt

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Plasma marker ACTH, cortisol, and beta-endorphins profile on pregnant wom as targeted marker of approach for antenatal depression

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Jatropha multifida L stem sap gel versus Aloe vera gel to post-gingivectomy healing process

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The impact of transcutaneous auricular vagus nerve stimulation on C-reactive protein in patients with chronic low back pain

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The percentage of positive biopsy cores in predicting biochemical recurrence and adverse pathology in prostate cancer patients after radical prostatectomy: a systematic review and meta-analysis

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Brain-derived neurotrophic factor (BDNF) and the capute scales in offspring c mothers with normal and deficient vitamin D levels

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The effect of low-intensity intradialytic aerobic exercise on heart rate variability in maintenance hemodialysis patients

Dilia Ratna Dewi, Damayanti Tinduh, Andriati, Mochammad Thaha, Mohammad Fathul Qorib, Soenarnatalina Melaniani

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Effect of Spiramycin and Moringa leaf feeding in improving placenta, heart, histopathological neurons and glia in fetal models with toxoplasmosis

Hafi Nurinasari, Sajidan, Bambang Purwanto, Dono Indarto, Didik T Subekti, Hendrastuti Apriningsih, Ariva Syiva'a, Soetrisno

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The significance of immunoexpression of Polo Like Kinase 1 (PLK1) in retinoblastoma

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Yan Adhitya Kusuma, Dyah Fauziah, Anny Setijo Rahaju

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Understanding of home care and interest level of nursing students working as home care nurses

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Relations between the incidence of endometriosis and type 1 epithelial ovarian cancer at M Djamil Central Hospital of Padang Indonesia

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Tumour infiltrating lymphocysts (TILs) as an excellent predictive factor for neoadjuvant chemotherapy response on locally advanced rectal cancer patie

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Prevalence and susceptibility profile of carbapenem-resistant pseudomonas aeruginosa (CRPA) at Dr. Soetomo Public Hospital, Surabaya, from January to December 2021

Andritta Febriana, Agung Dwi Widodo, **Muhammad Vitanata Arfijanto**

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Assessment of nutrient intake and antenatal education method for pregnant women in Gianyar, Bali, Indonesia

Ni Wayan Ariyani, Ni Luh Putu Sri Erawati

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Mayo Endoscopic Score (MES) as a reference for the histological active disease of ulcerative colitis

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Copeptin levels as a predictor of acute kidney injury (AKI) in ST-segment elevation myocardial infarction (STEMI)

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Spiritual care on quality of life patients exposed to COVID-19 in the city area of Semarang

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Diagnostic test thyroid elastography examination and mRNA expression of th Cytokeratin-19 gene to determine the type of thyroid nodule

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Postoperative complications of Mathieu incised plate versus standard tubularized incised plate urethroplasty for distal hypospadias: a systematic review and meta-analysis

Muhammad Arif Hakim Jamhari, Ilham Akbar Rahman, Muhammad Rifki Setiawan, Sirin Salsabila, Johan Renaldo, Mohammad Ayodhia Soebadi

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Unmet need for Family Planning (FP) in 7 national development areas in Indonesia

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Risk factors and clinical outcomes of ventilator associated pneumonia in neonates in the Neonatal Intensive Care Unit of Dr. Soetomo Hospital Surabaya

Deni Widya Ratna, Ni Made Mertaniasih, Risa Etika, Pepy Dwi Endraswari, Naritha Vermasari

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Triple-layered composite mesh for managing anterior abdomen wall defects in ventral hernia

Riana Pauline Tamba, Candy, Ahmad Yani, Rizky Amaliah

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Correlation of 5-minutes heart rate variability with health performance of resident physicians in covid 19 pandemic

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Adjusted enhanced recovery after surgery (ERAS) protocol in colorectal surgery at dr. Cipto Mangunkusumo General Hospital, Jakarta

Andre Setiawan Suryadi, Vania Myralda Giamour Marbun, Arnetta Naomi Louise Lalisang, Wifanto Sadiyah Jao, Yarman Mazni, Toar Jean Maurice Lalisang

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Effectiveness of topical turmeric extract compared to topical zinc on fibroblast count and collagen density in clean-contaminated wound: a study on new zealand white rabbit

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Clinical manifestations of allergic reactions and immunoglobulin E levels on allogeneic freeze-dried platelet-rich plasma (PRP) application

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Post-chemotherapy response of paclitaxel and carboplatin regimens in advanced stage cervical cancer types of histopathology squamous cell carcinoma and adenocarcinoma

Yohanes Adhitya Prakasa Sukoco, Meitria Syahadatina Noor, Ferry Armanza, Hariadi Yuseran, Renny Aditya

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Effects of Lactobacillus plantarum IS-10506 on gastric protective mucosal factors: an ibuprofen-induced gastric mucosal injury

Andy Darma, Wibi Riawan, Khadijah Rizky Sumitro, Alpha Fardah Athiyah, Reza Ranuh, Mohammad Fathul Qorib, Ingrid Surono, Subijanto Marto Sudarmo

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The relationship between metabolic acidosis as a predictive factor of mortality in Ludwig's Angina patients at Dr. Soetomo General Hospital, Surabaya, Indonesia

Alif Rakhman Prima Adi, Marjono Dwi Wibowo, Dwi Hari Susilo

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Correlation between the number of Interstitial cells of Cajal (ICC) and defecation pattern in patients with Hirschsprung's disease after Duhamel's surgery at General Hospital Dr. Soetomo

Yohanes Santosa Honggowarsito, Adria Hariastawa, Fendy Matulatan, Alphanah Rahniayu

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Sarcopenia as an indicator of nutritional status and outcome predictor for colorectal cancer in Javanese ethnic

Damianus Hipolitus, Adeodatus Yuda Handaya, Agus Barmawi

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Comparison of chlorhexidine 0.7% and modified Petroff's method on sputum decontamination for culture method to detect Mycobacterium tuberculosis

Rizky Hurriah Lumbessy, Ni Made Mertianiasih, Lindawati Alimsardjono, Soedarsono Soedars

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Comparison of agility between the flat foot and normal foot in East Java Puslatda athletes

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Exercise improving balance function in the older adult with locomotive syndrome stage 1: a randomized clinical trial

Bobby Kennedy, Damayanti Tinduh, Ditaruni Asrina Utami, I Putu Alit Pawana, Soenarnatalina Melaniani

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The impact of COVID-19 vaccination for healthcare workers on the SARS-CoV-2 antibody titers in a tertiary hospital in Jakarta, Indonesia

Rika Bur, Febby Elvanesa Sandra Dewi, Virmandiani, Yosanti Elsa Kartikawati, Meutia Gebrina, Aditya Rifqi Fauzi, Duddy Mulyawan, Ni Sayu Dewi Budhiyani

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Factors that determine inpatient satisfaction on nursing care: a cross-section study

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Development of nursing learning program for COVID-19 patients with e-learning method for nursing department students Poltekkes Ministry of Health Jayapura Papua

Blestina Maryorita, Jems Kifen Roget Maay

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Performance comparison between Conventional Polymerase Chain Reaction and AbTes Real-time polymerase chain reaction with the gold standard of microscopy imaging detection method

Puspa Wardhani, Aryati, Nur Chamidah

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Profiles of patients with maxillofacial fractures in emergency department of head and neck surgery division of Dr. Soetomo General Hospital Surabaya in 2021 during COVID-19 pandemic

Kevin Adrian, Marjono Dwi Wibowo

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Efficacy of transcutaneous electrical nerve stimulation on slow transit constipation in children with cerebral palsy

Rifah Zafarani Soumena, Andy Darma, Reza Gunadi Ranuh, Prastiya Indra Gunawan, Alpha Fardah Athiyah, Khadijah Rizky Sumitro, Subijanto Marto Sudarmo

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Application for COVID-19 severity diagnosis and asynchronous telehealth: development and prototype of G-COV

Budi Yanti, Adinda Zahra Ayufi Ramadhani, Zarfah Fawwaz Muhamad, Rahmad, Al Yafi

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The effect of added Transcutaneous Vagus Nerve Stimulation (tVNS) on quality of life in patients with chronic low back pain: a randomized controlled trial

Muhammad Jasman Erwin Halim, Imam Subadi, I Putu Alit Pawana, Lydia Arfianti, Rwahita Satyawati, Soenarnatalina Melaniani

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The association between biofilm formation ability and antibiotic resistance phenotype in clinical isolates of gram-negative bacteria: a cross-sectional study

Irbasmantini Syaiful, Agung Dwi Wahyu Widodo, Pepy Dwi Endraswari, Lindawati Alimsardjono, Budi Utomo, Muhammad Vitanata Arfijanto

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Relationship between angiotensin-like-protein-2 levels and anti-mullerian hormone levels in polycystic ovary syndrome of reproductive age

Dyan Asih Rachmawati, Ashon Sa'adi, Budi Utomo, Arif Tunjungseto

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Rina Kurniawati, Mahendro Prasetyo Kusumo

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The impact of bullying on adolescent self-concept

Laili Nur Hidayati, Silfia Wahyuni

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Association between IL-6 rs1800795 and IL-1 β rs 16944 gene polymorphisms with clinical severity of COVID-19 patients in Surakarta, Central Java, Indonesia

Hendrastutik Apriningsih, Betty Surtawati, Reviono, Tonang Dwi Ardyanto -, Dewi Pratiwi, Hafii Nurinasari

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Cervical cancer screening and prevention among female gynecologic oncologists in Indonesia

Brahmana Askandar Tjokroprawiro, Indra Yuliaty, Laila Nuranna, Tofan Widya Utami, Tricia De Anggraeni, Khoirunnisa Novitasari, Renata Alya Ulhaq

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The frequency and determinants of executive dysfunction among patients with subacute phase of ischemic stroke in West Nusa Tenggara, Indonesia

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The effect of exercise using incentive spirometry on heart rate variability in patients after COVID-19 infection

Hilman Harisuddin, Imam Subadi, Nuniek Nugraheni Sulistiawati, Andriati, Soenarnatalina Melaniani

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Integrated antenatal care services with breastfeeding counseling practices to improve pregnant women's knowledge, skills and readiness for exclusive breastfeeding

Sudarmi, Baiq Iin Rumintang, Ni Putu Dian Ayu Anggreni, Siti halimatussyaadiah

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Effects of Tourniquet Inflation on Blood Pressure, Mean Arterial Pressure, and Pulse Rate during the Maintenance of Anesthesia Using a Combination of Dexmedetomidine and Isoflurane for Patients Undergoing Lower Extremity Surgery

Bayu Wijanarko, Christrijogo Sumartono, Belindo Wirabuana, Hardiono, Bambang Pujo Seme Prananda Surya Airlangga

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Comparison of conventional and electronic cigarette on formaldehyde in blood and alveolus histopathology in vivo

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High ratio of neutrophils to lymphocytes and high triglyceride levels in serum risk factors for pre-eclampsia

Anak Agung Ngurah Jaya Kusuma, Endang Sri Widiyanti, Anak Agung Gde Marvy Khrisna Pranamartha, Adytia Theopani Bineredo Damanik

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The validity and reliability of various footprint analysis in flatfoot diagnosis of competitive athletes

I Putu Juniarta, Damayanti Tinduh, Nuniek Nugraheni, I Putu Alit Pawana, Rosy Setiawati, Soenarnatalina Melaniani

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Infant temperament with anxiety postpartum mothers in primary health care Sleman, Indonesia

Riski Oktafia, Ema Anindita Berliyanti, Nur Azizah Indriastuti, Rini Rahmayanti

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Relationship between knowledge and medication adherence among patients with tuberculosis: a cross-sectional survey

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Declining in estimated glomerular filtration rate of chronic kidney disease patients after Ramadan fasting is independent of interleukin-6 serum level

Abdullah, Kurnia Fitri Jamil, Dharma Lindarto, Desi Salwani, Muhsin, Andri Baftahul Khairi, Maimun Syukri

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Overview of prolactin levels in patients with schizophrenia during antipsychotic therapy at HB. Saanin Mental Hospital Padang, Indonesia

Dita Hasni, Bayu Eka Surya, Mutiara Anissa, Debie Anggraini

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Postoperative supplementation effect of zinc and vitamin C in primary colonic anastomosis on peritonitis condition: A study on New Zealand rabbit

Luh Putu Neolita Pradnya Wineni, Adria Hariastawa, Ariandi Setiawan

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The compliance of Pasar Raya Padang merchants in implementing health protocol

Sri Siswati, Vebi Adiva, Ahmad Hidayat

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The Relationship between teeth brushing habits and tooth pain experienced in children with Autism Spectrum Disorder (ASD)

Alfina Octavia, Wustha Farani, Syaina Azzahra, Safira Meita Hapsari

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Perception and readiness of medical students and teaching staff to implement interprofessional education

I Gusti Ayu Sri Darmayani, Ida Bagus Amertha Putra Manuaba, Made Violin Weda Yani, I Gede Wikania Wira Wiguna, I Komang Wira Ananta Kusuma, I Gede Putu Supadmanaba

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The radiologic findings, positivity rate of culture method examinations, correlation with the type of lower respiratory secretion of adult pulmonary Tuberculosis (TB) patients

Dewi Yana, Ni Made Mertaniasih, Eko Budi Koendhori, Rosy Setiawati

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Administration of mesenchymal stem cell derivate secretome causes lower levels of Matrix Metalloproteinase-13, Aggrecanase-2, and Interleukin-1 β than hyaluronic acid in rabbit knee osteoarthritis

Cokorda Gde Oka Dharmayuda, I Ketut Siki Kawiayana, I Made Bakta, I Nyoman Mantik Astawa, Putu Astawa, Ida Bagus Putra Manuaba, I Ketut Suyasa, Anak Agung Ngurah Subawa, Heri Suroto, Luh Putu Lin Indrayani Maker

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Overcoming relapse experience in acute coronary syndrome patients

Al Afik, Yuni Sufyanti Arif, Abu Bakar, Riza Fikriana

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Diabetic ulcers prevention in the elderly for improving blood circulation of lower extremities with combination foot exercise therapy and electrophysical therapy

Agnes Dewi Astuti, Nang Randu Utama, Bernadetta Germia Aridamayanti

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Comparison between the time to detection of pathogenic and nonpathogenic microorganisms from blood culture specimens using the BACTECTM FX machine to determine the optimal incubation time

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The effectiveness of roll-on aromatherapy of calamansi orange peel essential oil (*Citrofortunella microcarpa*) on reducing anxiety and pain in labor

Yetti Purnama, Kurnia Dewiani, Suci Rahmawati, Linda Yusanti, Linda Yuliyani

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Which are the best in protecting the upper respiratory tract, KN95® or Acchadana®-herbal masks on IL-6 perspective?

Resti Ariani, Awal Prasetyo, Rina Puspita, Fathur Nur Kholis, Udadi Sadhana, Ika Pawitra M, Hermawan Istiadi

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Characteristic profiles of patients with diabetes mellitus and COVID-19 during the second epidemic wave in East Java, Indonesia: a retrospective study

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Results and cost analysis of Amplatzer® Ductal Occluder-ii, Nit Occlud® L \hat{e} Coil, and Konar-MF® ventricular septal defect occluder for percutaneous ventricular septal defect closure

Eka Gunawijaya, Ni Putu Veny Kartika Yantie, Anlidya Permatasari Gunawijaya

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Islamic nursing care implementation: patients' perception

Novita Kurnia Sari, Aspia Dwi Asriani

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Does transcutaneous Vagus Nerve Stimulation (tVNS) reduce pain intensity in chronic low back pain patients? A randomized controlled pilot study

Muhammad Jasman Erwin Halim, Lydia Arfianti, I Putu Alit Pawana, Soenarnatalina Melaniani

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Validity test of pre-screening developmental questionnaire (PDQ) and mother and child health (MCH) handbook for determining children's readiness to enter elementary school

Nurani Widiati, Ahmad Suryawan, Mira Irmawati

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Efficacy of tadalafil and l-arginine combination therapy compared with tadalafil only for the treatment of erectile dysfunction: A systematic review and meta-analysis

Donny Austine Wibisono, Furqan Hidayatullah, Fikri Rizaldi, Tarmono Djojodimedjo

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Association of appetite hormone levels with HbA1c in obese type-2 diabetes mellitus patients

Edward Kurnia Setiawan Limijadi, Nyoman Suci Widyastiti, Meita Hendrianingtyas, Banundari Rachmawati

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Pregnancy characteristics of patients with placenta accreta spectrum at Prof. I I.G.N.G. Ngoerah Hospital Denpasar, Bali-Indonesia during January 2020 - January 2022

Anak Agung Ngurah Jaya Kusuma, I Wayan Artana Putra, I Gde Sastra Winata, I Gusti Ngura Wiranta Permadi, William Alexander Setiawan

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The relationship of biofilm Staphylococcus aureus with degree of severity and infection in patients of chronic rhinosinusitis

Teuku Husni T.R, Karina Witary Ayu Siagian, Benny Kurnia

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Association between polymorphism loci rs7041, rs4588 in vitamin D-binding protein receptor gene with comorbid with mortality sepsis patients in intensiv care unit General Hospital M. Djamil Padang, West Sumatra

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Relationship between Beighton score, genders, body mass index, and quadriceps angle in East Java Training Athletes

Abdul Sapril, Imam Subadi, I Putu Alit Pawana, Dewi Poerwandari, Nurul Kusuma Wardani, Soenarnatalina Melaniani

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Experiences of HIV/AIDS women in planning their pregnancies during the COVID-19 pandemic

Nur Azizah Indriastuti, Erna Rochmawati, Luluk Rosida, Riski Oktafia, Rizka Mega Putri Ariya

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Improved abdomen muscle activity with interferential current therapy in cerebral palsy with constipation: a randomized controlled trial study

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Critical priority Multidrug-Resistant Organisms (MDROs) secondary infection among COVID-19 patients: hidden threat during a pandemic? A retrospective study

Irbasmantini Syaiful, Ni Made Mertaniasih, Lindawati Alimsardjono, Pepy Dwi Endraswari, Arie Utariani, Budi Utomo

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Prevalence of multidrug-resistant Escherichia coli isolated from Jember hospital food handler in Indonesia

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Factors affecting patient safety culture in the nursing section of a type C private hospital in Surakarta using structural equation modeling

Lobes Herdiman, Susy Susmartini, Dewani Asmara Sekartaji Pangau, I Gusti Ngurah Priamba

Enny Suswati, Supangat, Laksmi Indreswari, Farhatina Nur U'alifa, Faiza Nabila, Inas Gama Putri Hertian

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Helicobacter pylori detection in gastric biopsy: immunohistochemistry and toluidine blue comparison

Ayu Lidya Paramita, Firman Setiawan, Willy Sandhika, Ni Made Mertaniasih, Arthur Pohan Kawilarang, Budi Utomo

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Challenge in prominent grade IV hemorrhoid management: a case report

Bernardus Parish Budiono, Neni Susilaningsih, Sigit Adi Prasetyo, Melissa Angela Chionardes Ignatius Riwanto

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Time to detection of Mycobacterium tuberculosis using culture filtrate H37rv supplementation on MGIT 960 System

Resti Enggar Paweninggalih, Ni Made Mertaniasih, Eko Budi Koendhori, Soedarsono Soedarsono

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The effectiveness of incentive spirometry exercise on pulmonary function in COVID-19 survivors: a randomized controlled trial study

Rosa Indah Kusumawardani, Damayanti Tinduh, Andriati, Dewi Poerwandari, Isnin Anang Marhana, Soenamatalina Melaniani

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A novel preoperative scoring system to predict postoperative mortality after pancreaticoduodenectomy in pancreatic cancer patients at Dr. Soetomo General Hospital: a retrospective cohort study

Arland Chandra, Tomy Lesmana

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Locomotion training addition to regular aerobic exercise improves walking speed and two-step test of the institutionalized older adult with Locomotive Syndrome stage 1: a randomized controlled trial

Michael Prayogo, Rwahita Satyawati, Dyah Intania Sari, Damayanti Tinduh, Sri Mardjati Mei Wulan, Yukio Mikami, Soenamatalina Melaniani

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Balinese purnajiwa (Kopsia arborea Blume.) extract stimulates male rats' sexual behavior and plasma testosterone level

I Gede Putu Wirawan, Maria Malida Vernandes Sasadara, I Made Jawi, Ida Ayu Putri Darmawati, I Nyoman Wijaya, Anak Agung Keswari Krisnandika, I Gde Nengah Adhilaksman Sunyamurthi, I Gusti Ngurah Alit Susanta Wirya

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Number of e-cadherin and VEGF in WiDr cell line post-induced by extract ethanol Annona muricata leaf

Yoni Astuti, Agus Suharto, Sabtanti Harimurti, Helmi Hana Prinanda, Wahyu Joko Priambodo

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Association between immunoscore with lymphovascular invasion and clinical staging in colorectal cancer

Raden Achmad Hussein Fachruddin, Wifanto Saditya Jeo

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The evaluation of Acehnese people's health insurance from the welfare perspectives

Muhammad Yani, Rachmad Suhanda, Indrita Iqbalawati, Diah Ayu Puspandari, Hafasnuddin, Aditya Candra, Teuku Muhammad Ilzana, Teuku Muhammad Khaled, Cut Rizka Rahmi

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Low dose mannitol versus high dose mannitol to achieve brain relaxation in brain tumor surgery: a meta-analysis

Gunna Hutomo Putra, Irwan Barlian Immadoel Haq, Rahadian Indarto Susilo, Joni Wahyuhadi

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Role of myostatin protein in sarcopenia (aging muscle) after conditioned medium umbilical cord mesenchymal stem cells (secretome) therapy: mini review

Ronald Winardi Kartika, Veronika Maria Sidharta, Tena Djuartina, Ignatio Rika, Cynthia Retna Sartika, Kris Herawan Timotius

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Systematic review: andrographolide as a potential Anti-inflammatory treatment for psoriasis

Indira Dharmasamitha, Ni Kadek Warditiani, Luh Mas Rusyati, DK Wati, Made Agus Gelgel Wirasuta

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Steroid impact on the efficacy and safety of SARS-CoV-2 vaccine: a systematic review

Pujo Prawiro Negoro, Gatot Soegiarto, Laksmi Wulandari

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Evaluation of the Implementation of Objective Structural Clinical Examination (OSCE) in the Faculty of Medicine: a Literature Review

Ida Bagus Amertha Putra Manuaba, Made Violin Weda Yani

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Utilizing information technology for optimizing LBW care: a systematic review

Romdzati, Dessie Wanda

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Association between Ascaris lumbricoides infection and undernutrition in children: a systematic review and meta-analysis

Putra Brilliant Djohan, AmeliaAmelia Prasetyadi, Marcela Wirjanata, Nicolas Daniel Widjanarko, Antoninus Hengky, Ellen Wijaya, Yunisa Astiarani

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The important role of multi-sector partnership in stunting management in eas java: a literature review

Dini Setiarsih, Sa'bania Hari Raharjeng, Rizki Nurmalya Kardina, Paramita Viantri, Fildzah, Pratiwi Hariyani Putri, Achmad Syafiuiddin, Rizki Amalia, Karina Widowati

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Knowledge, attitude, and skills of partograph utilization among health workers: a systematic review

Alfun Dhiya An, Ova Emilia

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Hemostasis in liver surgery: Indonesian Society of Digestive Surgeons (IKAB consensus statements

Arnetta Naomi Lalisang, Adiarto Nugroho, Michael Tendean, Irwan, Indah Situmorang, Juliani A. Uwuratuw, Tomy Lesmana, Erik Prabowo, Adeodatus Y. Handaya, Agung A. Wibowo, Marie Mayasari, Yarman Mazni, Jeffri, Bambang Suprpto, Ahmad F. Fuadi, Fransiscus Arifin, Reno Rudiman, Toar J.M. Lalisang, Warsinggih

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Massage stimulation's effect on melatonin levels in preterm infants via vagal activity

Diah Budiarti, Ahmad Suryawan

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Evidence of Dioxin as Endocrine Disrupting Chemicals in the Development of Endometriosis: A Narrative Review

Shafira Meidyana

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REVIEW

The presence of stem cells in ovarian cancer: a review

Tricia Dewi Anggraeni, Jenivia Thiono, Intan Winta Pratiwi, Ariananda Hariadi, Tera Dria Kispa, Aria Kekalih, Brahmana Askandar, Lisnawati, Ani Retno Prijanti, Mohamad Farid Aziz, Haryono Winarto, Marselina Irasonia Tan, Andrijono

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Effectiveness of Small Group Discussions (SGD) to Improve Learning Outcon and Critical Thinking in Medical Student: a Literature Review

I Gusti Ayu Sri Darmayani

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Exclusive breast milk by working mothers as a new habit: a literature review

Dini Setiarsih, Rizki Amalia, Rizki Nurmalya Kardina

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Inflammatory markers for predicting severity, mortality, and need for intensive care treatments of a patient infected with covid-19: a scoping review

Satriya Pranata, Aric Vranada, Yunie Armiyati, Amin Samiasih, Siti Aisah, Anna Kurnia, Priyo Sasmito, Yanuan Ben Olina, Antonius Rino Chapo

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A systematic review and meta-analysis of the impact of obesity on postoperative outcomes for patients undergoing laparoscopic cholecystectomy

Natalia Maria Christina, Jeremiah Hilkih W Wijaya

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Healthy food for pregnant mother

Gde Ngurah Indraguna Pinatih

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Mesona palustris BL: the potential antioxidant

Rahmah, Harsono Salimo, Brian Wasita, Eti Poncorini Pamungkasari, Risya Cilmiaty, Soetrisno

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Achievement of Decision-to-Delivery Interval in Emergency Caesarean Sectio Category 1 During the Covid-19 Pandemic: a Scoping Review

Dimas Mardiawan, Shinta Prawitasari

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Revealing the artemisinin and piperazine treatment failure: a systematic review

Farindira Vesti Rahmasari, Mallika Imwong, Irfanul Chakim, Winny Setyonugroho, Tri Wulandari Kesetyaningsih, Agus Gunadi, Desto Arisandi

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Curcumin, a potential oral herbal male contraceptive: a review article

Hilwah Nora, Rajuddin , Hafizudin , Rachmad Suhanda, Ima Indirayani

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Acute Lymphoblastic Leukemia (B-ALL) with co-expression of CD33 and CD13

Kustiah, Yetti Hernaningsih

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Management of bilateral nubbin testis, past and present controversies: a case report

Dian Adi Syahputra, Vita Indriasari, Fransiska Kusumowidagdo

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CASE REPORT

Bilateral keratoconus hydrops in a patient with Down Syndrome: a case report

Elfa Ali Idrus, Arief Akhdestira Mustaram, Angga Fajriansyah, Patriotika Muslima

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CASE REPORT

Interrupted aortic arch detected 4 days after surgical ventricular septal defect and patent ductus arteriosus closure: a case report

Pribadi Wiranda Busro, Indriwanto Sakidjan, Fathy Zuandi Pohan, Ameru Ulfalian, Chaidar Muttaqin, Hari Agung Asari

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Palliative management of a patient with gastric outlet obstruction (GOO) due to caput pancreatic cancer during COVID-19 pandemic

Fitria Rettobyaan, Budi Widodo

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A naive human immunodeficiency virus (HIV) patient with extrapulmonary tuberculosis manifestation: diagnosis and management challenges

Faradika Nopta Hadiatma, Erwin Astha Triyono

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Radiotherapy for primary angiosarcoma of the breast: a case report

Yoke Surpri Marlina, Rima Novirianythy, Teuku Muhammad Yus

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Prevalence and susceptibility profile of carbapenem-resistant pseudomonas aeruginosa (CRPA) at Dr. Soetomo Public Hospital, Surabaya, from January to December 2021



Andritta Febriana¹, Agung Dwi Widodo^{2*}, Muhammad Vitanata Arfijanto³

ABSTRACT

Introduction: *Pseudomonas aeruginosa* is a pathogen that frequently causes healthcare-associated infections (HAI), which has also been associated with high mortality and morbidity rates. Carbapenems have been widely utilized as empiric therapy for *P. aeruginosa* infections since these organisms have intrinsic resistance to various antibiotics. Therefore, the high rate of CRPA infection became the reason for conducting this study to determine the prevalence and susceptibility pattern of CRPA in Dr. Soetomo Public Hospital, Surabaya, from January to December 2021.

Method: The researcher employed descriptive observational study from secondary data with the first isolate sample of *P. aeruginosa* per specimen per patient that has been identified by the BD Phoenix™ automated identification and susceptibility testing system from specimens of urine, blood, sterile fluid, pus, tissue, and sputum that are phenotypically resistant to meropenem or imipenem antibiotics, examined at the Clinical Microbiology Unit of Dr. Soetomo Public Hospital, Surabaya, from January to December 2021.

Result: Of the total *P. aeruginosa* isolates, 149 CRPA isolates were obtained. The researcher conveyed that the majority of the samples were male (59.1%); the most comorbid cases were diabetes mellitus with complications (22.4%) found in the intensive care unit (40.3%); the majority of specimens were from the respiratory tract (43%); the highest antibiotic susceptibility was amikacin (62.4%); the prevalence of CRPA in Dr. Soetomo Public Hospital, Surabaya, from January to December 2021 reached 21.25%.

Conclusion: In this study, CRPA isolates showed the highest sensitivity to amikacin, and the highest distribution of CRPA events was found in the intensive care unit.

Keywords: CRPA, incidence rate, susceptibility profile.

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INTRODUCTION

The worldwide increase in infection with multidrug-resistant gram-negative (MDR) pathogens is a crucial global health problem. Southeast Asia has a high prevalence of MDR gram-negative bacteria, including multidrug-resistant non-fermenters such as *P. aeruginosa*.^{1,2} *P. aeruginosa* is an opportunistic pathogen that requires minimal nutrition for its survival, enabling it to easily adapt to and survive in an environment with extreme conditions, such as a hospital environment.^{3,4} These pathogens are commonly found on abiotic surfaces such as medical equipment, rooms, and showers and even can contaminate distilled water, and are widely isolated, especially in

immunocompromised patients, patients treated in the ICU, or patients with severe comorbidities.^{5,6} Thus, *P. aeruginosa* is commonly linked to healthcare-associated infections.^{7,8}

P. aeruginosa has an innate resistance to several antibiotics, such as ampicillin, amoxicillin, ampicillin-sulbactam, amoxicillin-clavulanic acid, cefotaxime, ceftriaxone, ertapenem, tetracycline, and tigecycline.^{9,10} Carbapenem is a broad-spectrum β -lactam antibiotic with bacterial cell wall synthesis inhibitory activity. Carbapenem has extremely high potency against Gram-negative and Gram-positive bacteria among other β -lactam drugs. In addition, carbapenem is a last-line drug for treating cases of patients with MDR pathogenic infections, including *P.*

aeruginosa.^{7,11,12} The cause of carbapenem-resistant *P. aeruginosa* (CRPA) is generally acquired due to a chromosomal mutation that causes loss or inactivation of the OprD (Outer membrane protein D) porin and/or overexpression of the efflux pump. Resistance to carbapenems can also be obtained through the acquisition of horizontal gene transfer (HGT) of the gene encoding carbapenemase. This B-lactamase is capable of hydrolyzing carbapenems and provides resistance to all β -lactam antibiotics.^{8,13,14}

The increase in CRPA rates can be caused by the emergence of resistance in these organisms after exposure to carbapenems and can occur due to the spread of CRPA from patient to patient.¹⁵ Resistance to these carbapenems,

especially when mediated by transferable carbapenemase-coding genes, can spread rapidly and cause outbreaks.¹¹ The increase in CRPA cases has become significant health and economic issue that deserves more attention given the limited options for an effective and safe therapy.^{1,16} In addition, carbapenemase-producing CRPA strains cannot be treated with classical β -lactamase inhibitors, thus, it can lead to poor clinical conditions, such as an increased risk of mortality, morbidity, length of hospitalization, and increased treatment costs.⁵

HAI-related CRPA cases have increased globally in recent years.^{5,17} In 2017, WHO classified CRPA as a priority pathogen of the 'critical pathogen' category for research and development of the latest antibiotics.¹⁸ In Indonesia, the incidence of CRPA from the ICU of Dr Cipto Mangunkusumo Hospital reached 21.9% in 2011.¹⁹ Based on the surveillance of antibiotic resistance in class A and B hospitals in Indonesia in 2020, the prevalence of CRPA amounted to 25% of all specimens and rooms from all hospitals.²⁰ Therefore, the high rate of CRPA infection became the reason for conducting this study to determine the prevalence and susceptibility pattern of CRPA in Dr. Soetomo Public Hospital, Surabaya, from January to December 2021.

MATERIAL AND METHODS

The research sample included all data on *Pseudomonas aeruginosa* isolates identified by the BD Phoenix™ automated identification and susceptibility testing system from urine, blood, sterile fluid, sputum, pus, and tissue specimens that are phenotypically resistant to carbapenem antibiotics examined at the Clinical Microbiology Unit of Dr. Soetomo Public Hospital, Surabaya. The isolates taken were the first isolates from each type of

specimen in the same patient from January 1 to December 31, 2021. This research was approved by the Health Research Ethics Committee of Dr. Soetomo Public Hospital, Surabaya, based on Ethical Clearance No. 1411/122/4/IV/2022.

The data analyzed in this study included CRPA distribution by age and sex, CRPA distribution by comorbidities, CRPA distribution by the patient clinical outcome, CRPA distribution by care unit, CRPA distribution by the specimen, and CRPA antibiotic susceptibility pattern.

The data on the results of the antibiotic susceptibility test of carbapenem resistant *P. aeruginosa* (CRPA) isolates were stated in the Susceptible, Intermediate, and Resistant categories. The methods employed were disk diffusion for testing the antibiotic, such as fosfomycin, and the semi-automatic BD Phoenix™ automated identification and susceptibility testing system for testing antibiotics, such as gentamicin, amikacin, imipenem, meropenem, ceftazidime, cefepime, ciprofloxacin, levofloxacin, aztreonam, piperacillin-tazobactam, according to the group *P. aeruginosa* test at the Clinical and Laboratory Standards Institute (CLSI). The data obtained were presented in the form of tables containing frequency and percentage data for analysis.

RESULTS

This research collected 701 data from culture and susceptibility test of *P. aeruginosa*, which was divided into 149 (21.25%) carbapenem-resistant *P. aeruginosa* (CRPA) and 552 carbapenem susceptible *P. aeruginosa* (CSPA), which derived from all specimens of blood, sterile fluid, urine, sputum, pus, and tissue recorded at the Clinical Microbiology unit of Dr. Soetomo Public Hospital, Surabaya. Based on the distribution data of the study sample, CRPA was most commonly found

in the male sex, reaching 88 (59.06%) people, while in the female sex, it reached 61 (40.93%) people. Meanwhile, based on the distribution of samples by age, the most CRPA was found in patients aged > 45 years, as many as 78/149 (52.34%), which were divided into middle age adults (54 patients or 36.2%) and seniors adult (24 patients or 16.1%), as presented in [table 1](#).

The distribution of CRPA patients with comorbid factors based on the Charlson comorbidity index indicated that 107/149 (71.81%) patients had comorbidities and one patient could have more than one comorbid. The highest frequency of comorbidity was diabetes, which reached 42 (28.18%) cases, which was divided into 18 (12.1%) cases of diabetes without complications and 24 (16.1%) cases of diabetes with complications. The second most common comorbidities were Cerebrovascular disease and chronic lung disease, each with 12 (8.1%) cases ([Table 2](#)).

This study revealed that more than 70% of patients were estimated to have comorbidities, but no specific comorbidities were associated with an increased risk of CRPA incidence. The most comorbid in this study was diabetes, which reached 28.18% of cases, divided into diabetes without complications (12.1%) and diabetes with complications (16.1%). The clinical outcomes of CRPA patients in this study demonstrated that 88 (59.06%) patients were alive and 61 (40.93%) patients were deceased ([Table 3](#)). From all care units, the highest number of CRPA was found in intensive care units, including ICU, NICU, ROI, and HCU rooms, which reached 60 (40.3%) cases, followed by surgical care unit, amounting to 32 (21.5%) cases ([Table 4](#)).

The highest incidence of CRPA derived from respiratory tract specimens which

Table 1. CRPA distribution by age and sex.

Age (years)	Toddler (0-5)	Child (6-11)	Teenager (12-25)	Adult (26-45)	Middle Age Adult (46-65)	Senior Adult (> 65)	Total
Male	15 (17%)	5 (5.7%)	10 (11.4%)	14 (15.9%)	35 (39.8%)	9 (10.2%)	88 (59.06%)
Female	5 (8.2%)	0 (0.0%)	7 (11.5%)	15 (24.6%)	19 (31.1%)	15 (24.6%)	61 (40.93%)
Total	20 (13.4%)	5 (3.4%)	17 (11.4%)	29 (19.5%)	54 (36.2%)	24 (16.1%)	149 (100%)

reached 64 (43%) specimens, which consisted of 23 spontaneous sputum specimens, 40 endotracheal tube aspirates, and 1 bronchial lavage. CRPA isolates from pus specimens were 41 (27.5%) specimens, from urine specimens were 30 (20.8%) specimens, from blood specimens were 8 (5.4%) specimens, and from sterile fluid specimens were 5 (3.4%) specimens (Table 5).

The results of the antibiotic susceptibility test of all CRPA isolates demonstrated the highest susceptibility to *amikacin* as much as 93/149 (62.4%), followed by *piperacillin-tazobactam* at 57/149 (38.3%), *aztreonam* at 40/149 (26.8%), *gentamicin* at 38/148 (25.7%), *ceftazidime* at 31/148 (20.9%), *cefepime* at 28/148 (18.9%), *ciprofloxacin* (17.4%), *levofloxacin* (16.2%), *meropenem* (13.5%), *fosfomycin* (10.7%),

and *imipenem* (2.7%). The highest number of CRPA isolates resistant to *imipenem* antibiotics was 140/149 (94%) isolates. *Fosfomycin* revealed resistance of 122/140 (87.1%), *cefepime* and *levofloxacin* each of 120/148 (80.5%), *ciprofloxacin* of 119/149 (79.9%), *meropenem* of 117/148 (79.1%), and *gentamicin* of 106/148 (71.6%) (Figure 1).

DISCUSSION

In this study, the prevalence of CRPA reached 21.25% which is in line with previous study which revealed the prevalence of CRPA from the ICU of Dr. Cipto Mangunkusumo Hospital in 2011 was 21.9%.²¹ However, the prevalence of CRPA in this study was not restricted to the ICU. The results of this study were higher than the study conducted by Tartof et al. (2018) which demonstrated a prevalence of CRPA of 20.2% in hospitalized patients in 14 medical centers from 2011 to 2015.²² Meanwhile, other study revealed the prevalence of HAIs caused by CRPA was 40%, however, this study did not distinguish between HAIs patients and non-HAI patients.¹⁹

Based on the aforementioned data, CRPA was mostly found in male patients (59.06%). These data are in accordance with a study conducted by Kang et al. (2003), which demonstrated that most patients with CRPA were male (66.2%).²¹ Similarly, in their study, Tartof et al. (2018) also revealed that most patients with CRPA were male (59.4%).²² In this study, patients over 45 were identified to have the highest prevalence of CRPA. Male patients from middle age adults to senior adults included in the category with higher rates of infection acquisition. This result is in line with other research findings that age has become a significant risk factor for *P. aeruginosa* infection and that nosocomial infection generally occurs in males.^{23,24} Additionally, elderly patients are more susceptible to infection with multiresistant microorganisms. This is brought on by a decline in immune system activity, which also affects the body's structure and function, leading to other conditions such as the necessity for a catheter, malnutrition, and prolonged treatment.^{5,26}

The most comorbid in this study was diabetes, in a study conducted by

Table 2. CRPA distribution by comorbidity.

Comorbidity	Total (n= 107)
Diabetes with complications	24 (22.4%)
Diabetes without complications	18 (16.8%)
Cerebrovascular disease	12 (11.2%)
Chronic lung disease	12 (11.2%)
Mild liver disease	11 (10.3%)
Malignant solid tumor	11 (10.3%)
Kidney illness	10 (9.3%)
Peripheral vascular disease	8 (7.5%)
Tumors with metastases	5 (4.7%)
Congestive heart failure	3 (2.8%)
Acute myocardial infarction	2 (1.9%)
HIV/AIDS	2 (1.9%)
Hemiplegia/paraplegia	2 (1.9%)
Dementia	1 (0.9%)
Leukemia	1 (0.9%)
Lymphoma	1 (0.9%)
Rheumatism	0 (0%)
Moderate to serious liver disease	0 (0%)
Peptic ulcer	0 (0%)

Table 3. CRPA distribution by patient clinical outcome.

Living Patient n (%)	Deceased patient n (%)	Total n (%)
88 (59.06%)	61 (40.93%)	149 (100%)

Table 4. CRPA distribution by care unit.

Care Units	CRPA n (%)
ICU, NICU, ROI, HCU	60 (40.3)
Surgical Care Unit	32 (21.5)
Medical Care Unit	27 (18.1)
Pediatric Care Unit	15 (10.1)
Special Isolation Room	5 (3.4)
Obstetrics and Gynaecology	4 (2.7)
Emergency Room	6 (4)
Total	149 (100)

Table 5. CRPA distribution by specimen.

Blood n (%)	Sterile fluid n (%)	Sputum n (%)	Urine n (%)	Pus and tissue n (%)	Total n (%)
8 (5.4)	5 (3.4)	64 (43)	31 (20.8)	41 (27.5)	149 (100)

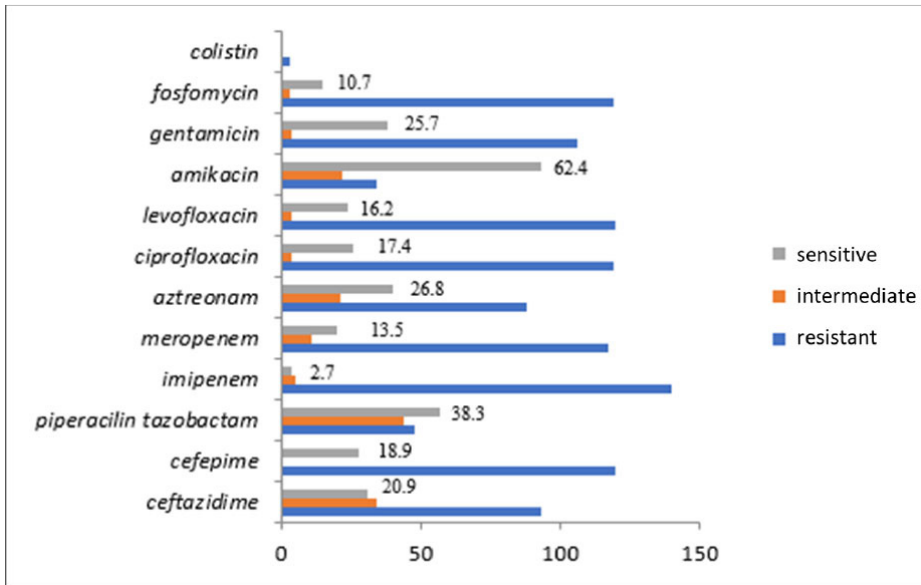


Figure 1. CRPA antibiotic susceptibility pattern.

Palavutittoi (2018), diabetes was the third most common comorbid after hypertension and chronic kidney disease (CKD).⁷ Patients with CRPA infection have a higher risk of receiving appropriate antimicrobial therapy late, resulting in prolonged hospitalization, increased risk of subsequent antibiotic-resistant infections, as well as increased morbidity and mortality.^{22,27} The presence of virulence factors such as flagella, pili, and lipopolysaccharides as well as biologically active processes such as toxin secretion, biofilm formation, and quorum sensing has an impact on the outcome of *P. aeruginosa* infection.²⁵ In this study, the mortality rate reached 40.93%. Suarez et al., (2009) stated that CRPA was not associated with a higher mortality rate in hospitalized patients with bacteremia.²⁸

The global incidence of nosocomial infections caused by *P. aeruginosa* was estimated at 10-15% and around 10-20% was obtained from intensive care units.^{29,30} These research findings are in line with the research conducted by Tartof et al. (2018).²² The high rate of cross-transmission in intensive care units (Zavascki et al., 2006) and the use of a variety of broad-spectrum antibiotics in the ICU (Alhussain, 2021) contributed significantly to the incidence of CRPA infection.^{23,31} In addition, the use of invasive medical devices, such as the installation of ventilators and urinary catheters, are also at risk for infection

with CRPA. Patients in the intensive care unit are patients with severe diseases who frequently require invasive medical devices, which increases their risk of recurrent infections and complications.⁷ Several studies have discovered that using invasive medical devices is a significant determinant of CRPA.²² Patients on a ventilator have eleven times higher risk of infection with *P. aeruginosa* than those without a ventilator.²³

In this study, the most CRPA specimens were obtained from respiratory tract samples, i.e., sputum by 43%, where this result is in line with research conducted by Zavascki et al. (2006) with 50.3% specimens³¹; Karuniawati (2011)¹⁹ with 61/81 (75%) specimens; Tartof et al. (2018) with 61.45% specimens²²; and Alhussain (2021) with 60% specimens¹⁴. In this regard, Hospital Acquired Pneumonia (HAP) and Ventilator-Associated Pneumonia (VAP) were the most common nosocomial infections.³² *P. aeruginosa* was the most common cause of hospital pneumonia, the third most common cause of urinary tract infection, the fourth most common cause of surgical site infection, and the seventh most common pathogen isolated from blood.

P. aeruginosa has a strong tendency to become a pathogen that is resistant to various intrinsic and acquired antibiotics.⁸ *P. aeruginosa* susceptibility decreased significantly to carbapenem, ceftazidime,

and ciprofloxacin (Alhussain, 2021).¹⁵ Additionally, *P. aeruginosa* is able to survive for a long time even under unfavorable conditions. These bacteria have various virulence factors, one of which produces biofilms that play a major role in the occurrence of nosocomial infections and resistance to antibiotics.^{33,34}

CRPA is often resistant to various drugs, causing difficulties in treating and controlling the infection.³⁵ In this study, CRPA resistance ranged from 22.8 - 80.5% with the highest susceptibility to amikacin (62.4%), while susceptibility to other antipseudomonal ranged from 2.7 - 38.3%. This study is in line with the research conducted by Alhussain et al. (2021) which indicated the highest susceptibility to amikacin at 86.7%.²³ Meanwhile, research conducted by Anggraini et al. (2018) showed that MDR-PA had the highest susceptibility to amikacin at 50.9%, lower than the susceptibility of amikacin in non-MDR-PA strains of 76.9%.³⁶ CRPA has more resistance than CSPA.^{22,35} Amikacin is a semisynthetic aminoglycoside that is extremely resistant to enzyme modification, so many bacteria are sensitive to this antibiotic. A fairly good susceptibility to amikacin indicates that the use of amikacin is not too frequent considering that amikacin may cause the side effects of ototoxicity and nephrotoxicity.³⁶

Colistin is the last line of therapy for CRPA multidrug treatment. The analytical study conducted by Goli et al. (2016) and Sheikh et al., (2019) revealed that colistin still has a good susceptibility value to MDR CRPA infection. However, these antibiotics are rarely used since they are nephrotoxic and neurotoxic.^{37,38} Although the prevalence of resistance to colistin is still low, the incidence of resistance to colistin has been reported in various countries.^{37,38} In this study, only three CRPA isolates were tested against colistin with 100% of the isolates being resistant. Due to the limited number, this statement cannot generally be concluded.

The increased incidence of imipenem resistance in *P. aeruginosa* is often associated with resistance to other antipseudomonal drugs. This statement is in line with the research conducted by Palavutittoi et al. (2018), which

demonstrated that among the CRPA strains, 53.5% were XDR-PA, and 24.8% were MDR-PA. Patients with the XDR-PA strain tended to receive inappropriate empiric therapy and as many as 78.6% of them received carbapenem monotherapy.⁷

CRPA is generally acquired as a result of chromosomal mutations leading to loss or inactivation of the OprD porin and/or overexpression of the efflux pump. Resistance to carbapenems can also be obtained through the acquisition of horizontal gene transfer (HGT) of the gene encoding carbapenemase. This B-lactamase is able to hydrolyze carbapenems and provides resistance to all classes of β -lactam antibiotics (Botelho et al., 2019).⁵ Additionally, increased CRPA can be caused by selective pressure due to exposure to antibiotics and transmission through health workers or between patients. Thus, it requires efforts to control and prevent nosocomial infections as well as strict regulation and monitoring in the wise and rational use of antibiotics.¹⁵ This study had several limitations, including (1) The sample size of this study was limited to 149 inpatients at one hospital. (2) this research was conducted in Surabaya, so the situation may be different in other countries. (3) This study did not routinely test susceptibility to colistin. (4) Clinical data, laboratory and duration of use of antibiotics were not included in this study.

CONCLUSION

In this study, CRPA isolates showed the highest sensitivity to amikacin, and the highest distribution of CRPA events was found in the intensive care unit. The findings of this study are of paramount relevance for case identification, control measures, and optimal treatment strategies of *P. aeruginosa* infection in ICUs. The increasing prevalence of antimicrobial resistance among hospitalized patients continues to pose a challenge for practitioners.

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CONFLICT OF INTEREST

The authors declare that they have no financial or personal conflicts of interest in this work.

AUTHOR CONTRIBUTION

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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