



KEMENTERIAN RISET DAN TEKNOLOGI /  
BADAN RISET DAN INOVASI NASIONAL  
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Nomor : B/112/E3/RA.00/2021 18 Februari 2021  
Lampiran : 3 (Tiga) Berkas  
Hal : Pengumuman Penerima Pendanaan Penelitian di Perguruan Tinggi  
Tahun Anggaran 2021

- Yth. 1. Rektor/ Direktur/ Ketua Perguruan Tinggi Negeri dan Swasta  
2. Kepala Lembaga Layanan Pendidikan Tinggi Wilayah I s/d XV

Berdasarkan Keputusan Kuasa Pengguna Anggaran Deputy Bidang Penguatan Riset dan Pengembangan Kementerian Riset dan Teknologi/ Badan Riset dan Inovasi Nasional Nomor 8/E1/KPT/2021 tanggal 01 Februari 2021 tentang Penetapan Pendanaan Penelitian di Perguruan Tinggi Negeri Badan Hukum Tahun Anggaran 2021, Keputusan Kuasa Pengguna Anggaran Deputy Bidang Penguatan Riset dan Pengembangan Kementerian Riset dan Teknologi/ Badan Riset dan Inovasi Nasional Nomor 9/E1/KPT/2021 tanggal 01 Februari 2021 tentang Penerima Pendanaan Penelitian di Perguruan Tinggi Tahun 2021 untuk Penelitian Tahun Jamak Lanjutan Tahun 2019, Keputusan Kuasa Pengguna Anggaran Deputy Bidang Penguatan Riset dan Pengembangan Kementerian Riset dan Teknologi/ Badan Riset dan Inovasi Nasional Nomor 10/E1/KPT/2021 tanggal 01 Februari 2021 tentang Penerima Pendanaan Penelitian di Perguruan Tinggi Tahun 2021 untuk Penelitian Tahun Jamak Lanjutan Tahun 2020, dan Keputusan Kuasa Pengguna Anggaran Deputy Bidang Penguatan Riset dan Pengembangan Kementerian Riset dan Teknologi/ Badan Riset dan Inovasi Nasional Nomor 11/E1/KPT/2021 tanggal 01 Februari 2021 tentang Penetapan Pendanaan Penelitian di Perguruan Tinggi Tahun Anggaran 2021, bersama ini kami sampaikan daftar nama penerima pendanaan Penelitian tahun anggaran 2021 sebagai berikut:

1. Penerima Pendanaan Penelitian di Perguruan Tinggi PTNBH Tahun Anggaran 2021 (**Lampiran I**)
2. Penerima Pendanaan Penelitian di Perguruan Tinggi Non-PTNBH Tahun Anggaran 2021 (**Lampiran II**)

Kami informasikan bahwa penerima pendanaan Penelitian Tahun Anggaran 2021 adalah Peneliti dengan ketentuan sebagai berikut:

1. Pengusul yang proposalnya dinyatakan lolos seleksi, yang bersangkutan atau institusi telah memenuhi kewajiban sebagai berikut:
  - a. Mengunggah laporan kemajuan sampai dengan tahun 2020;
  - b. Mengunggah laporan akhir sampai dengan tahun 2020;
  - c. Melaksanakan seluruh tahapan seleksi sebagaimana disebutkan dalam Panduan Pelaksanaan Penelitian dan Pengabdian Masyarakat Perguruan Tinggi Edisi XIII Tahun 2020 untuk PTNBH dan skema penelitian Desentralisasi bagi Perguruan Tinggi klaster Mandiri, Utama, dan Madya sesuai dengan hasil klasterisasi tahun 2019;
  - d. Melaksanakan monitoring dan evaluasi penelitian secara daring sebagaimana surat Direktur DRPM dengan Nomor B/1223/E3/RA.00/2020
  - e. Tidak sedang dalam status tugas belajar baik untuk ketua maupun anggota, kecuali anggota pada skema Penelitian Pascasarjana;
  - f. Pendanaan penelitian diberikan dengan memperhatikan kuota berdasarkan *h-index* peneliti, kecuali untuk skema Penelitian Pascasarjana yang tidak dihitung sebagai kuota.

2. Penelitian Kontrak Tahun Jamak 2019-2021 dan Kontrak Tahun Jamak 2020-2022 yang dilanjutkan pendanaannya merupakan penelitian yang telah dinyatakan layak berdasarkan hasil monitoring dan evaluasi pada tahun 2020;
3. Peneliti tahun anggaran 2020 yang ditunda pendanaan penelitiannya ke tahun anggaran 2021, telah mengisi konfirmasi kesediaan Peneliti untuk melaksanakan penelitian 2020 yang ditunda ke tahun anggaran 2021 sesuai dengan surat Direktur DRPM Nomor B/1176/E3/RA.00/2020.

Apabila ada penerima pendanaan penelitian sebagaimana tercantum pada lampiran ternyata tidak memenuhi salah satu dari ketentuan di atas, atau pelanggaran terhadap ketentuan Panduan Penelitian dan Pengabdian kepada Masyarakat Edisi XIII Tahun 2020 maka pendanaannya dapat ditinjau kembali.

Berkenaan dengan hal tersebut, DRPM mengucapkan selamat kepada penerima pendanaan penelitian tahun anggaran 2021. DRPM mengucapkan terimakasih kepada pengusul yang telah berpartisipasi, bagi pengusul yang belum mendapatkan pendanaan tahun ini dapat mengusulkan proposal penelitian untuk pendanaan tahun 2022. Selanjutnya, kami mohon bantuan Bapak/Ibu untuk menyampaikan informasi di atas kepada nama-nama yang tercantum pada lampiran di Perguruan Tinggi masing-masing.

Perlu kami sampaikan bahwa mekanisme penyaluran dana akan dilakukan melalui kontrak. Berkaitan dengan hal ini, perlu kami sampaikan beberapa hal sebagai berikut:

1. Terdapat dua jenis kontrak penelitian yang akan digunakan, yaitu kontrak tahun tunggal dan kontrak tahun jamak. Kontrak tahun tunggal digunakan untuk kontrak penelitian yang pendanaannya hanya 1 (satu) tahun, adapun kontrak tahun jamak digunakan untuk kontrak penelitian yang pendanaannya lebih dari 1 (satu) tahun;
2. Kontrak dilakukan secara berjenjang. Untuk Perguruan Tinggi Negeri (PTN), kontrak dilakukan antara DRPM dengan Ketua LP/LPPM/LPM/Direktur Politeknik, adapun untuk Perguruan Tinggi Swasta kontrak dilakukan melalui Kepala Lembaga Layanan Pendidikan Tinggi (LLDIKTI) masing - masing wilayah;
3. Pencairan dana penelitian dilakukan dengan 2 (dua) cara yaitu secara sekaligus dan secara bertahap;
4. Para penerima pendanaan penelitian akan diminta untuk mengunggah perbaikan proposal dan RAB sesuai dengan dana yang diterima. Informasi lebih rinci terkait pengunggahan perbaikan proposal akan disampaikan kemudian.
5. Hal-hal lain yang terkait dengan penandatanganan kontrak, pencairan dana, dan pelaksanaan penelitian akan diinformasikan lebih lanjut melalui laman: <http://simlibtamamas.ristekdikti.go.id>.

Berkaitan dengan data yang diperlukan untuk penandatanganan kontrak, bersama ini kami kirimkan **Daftar Isian (Lampiran III)**. Kami mohon Daftar Isian tersebut dapat diisi dan segera dikirim melalui laman google form dengan link <http://bit.ly/FormKontrakPenelitian2021> paling lambat tanggal **05 Maret 2021** untuk PTS tidak perlu mengirimkan daftar isian karena Kontrak akan dilakukan dengan LLDIKTI Wilayah masing – masing.

Demikian kami sampaikan, atas perhatian dan kerjasama Bapak/Ibu kami ucapkan terima kasih.



Plt. Direktur Riset dan Pengabdian Masyarakat,

Heri Hermansyah  
NIP 197601181999031002

Tembusan;  
Deputi Bidang Penguatan Riset dan Pengembangan

Lampiran I

Nomor : B/112/E3/RA.00/2021

Hal : Pengumuman Penerima Pendanaan Penelitian di Perguruan Tinggi Tahun Anggaran 2021

**PENERIMA PENDANAAN PENELITIAN DI PERGURUAN TINGGI NEGERI BADAN HUKUM  
TAHUN ANGGARAN 2021**

NO	NAMA INSTITUSI	SKEMA	NAMA	NIDN	JUDUL	DURASI PENELITIAN (Tahun)
1	Institut Pertanian Bogor	Penelitian Terapan Unggulan Perguruan Tinggi	A. FAROBY FALATEHAN	0030047604	Penguatan Kapasitas Kelembagaan Usaha Perkebunan Sawit Rakyat dalam Menunjang Digitalisasi Persawitan Masyarakat	2
2	Institut Pertanian Bogor	Penelitian Pendidikan Magister menuju Doktor untuk Sarjana Unggul	ACHMAD FARAJALLAH	0027046503	Sistematika Crustacea Laut di Indonesia	3
3	Institut Pertanian Bogor	Penelitian Pendidikan Magister menuju Doktor untuk Sarjana Unggul	ACHMAD FARAJALLAH	0027046503	Studi Filogeografi Crustacea Laut Indonesia	3
4	Institut Pertanian Bogor	Penelitian Dasar Unggulan Perguruan Tinggi	ACHMAD FARAJALLAH	0027046503	Pengembangan Tehnik eDNA untuk mengevaluasi populasi labi-labi di Indonesia	2
5	Institut Pertanian Bogor	Penelitian Pendidikan Magister menuju Doktor untuk Sarjana Unggul	ACHMAD FARAJALLAH	0027046503	Zoogeografi Ayam Asli Indonesia Di Kepulauan Sunda Kecil Dan Potensi Ayam Asli Indonesia Sebagai Ayam Pesuara	3
6	Institut Pertanian Bogor	Penelitian Disertasi Doktor	AGUS BUONO	0002076607	SISTEM PENUNJANG KEPUTUSAN PEMULIHAN STATUS PADA TRANSPORTASI SAPI BERDASARKAN PENGELOLAANNYA	2
7	Institut Pertanian Bogor	Penelitian Dasar Unggulan Perguruan Tinggi	AGUS GHATSUN NIAM	0011068206	Rancang Bangun Low Cost Aeroponic Chamber (LCAC) untuk Produksi Benih Alternatif Bawang Merah pada Lingkungan Terkendali	2
8	Institut Pertanian Bogor	Penelitian Dasar	AGUS KARTONO	0021047003	Prediksi Pandemi Covid-19 di Indonesia menggunakan Model Dinamika SIR dan SEIR Termodifikasi	2
9	Institut Pertanian Bogor	Penelitian Disertasi Doktor	AGUS SALEH ATMADIPOERA	0006076605	Analisis Pola Migrasi Ikan Pelagis Kecil berdasarkan parameter fisik dan biologi perairan di Sunda Shelf	2

**PENERIMA PENDANAAN PENELITIAN DI PERGURUAN TINGGI NEGERI BADAN HUKUM  
TAHUN ANGGARAN 2021**

NO	NAMA INSTITUSI	SKEMA	NAMA	NIDN	JUDUL	DURASI PENELITIAN (Tahun)
958	Universitas Airlangga	Penelitian Dasar	MARIA LUCIA INGE LUSIDA	0017095807	ISOLASI DAN OPTIMASI PROPAGASI SARS-CoV2 DARI SAMPEL KLINIS ISOLAT INDONESIA SERTA PEMANFAATANNYA DALAM PENELITIAN ANTIVIRAL	2
959	Universitas Airlangga	Penelitian Dasar Unggulan Perguruan Tinggi	MARTONO TRI UTOMO	0026017304	Peningkatan Kualitas Pelayanan Asfiksia Neonatorum	2
960	Universitas Airlangga	Penelitian Dasar Unggulan Perguruan Tinggi	MAS RAHMAH	0012097104	MODEL PATEN OBAT DARI TANAMAN TRADISIONAL INDONESIA DENGAN "DISCLOSURE OF ORIGIN" UNTUK MENUNJANG PROGRAM OBAT MURAH DAN MEWUJUDKAN KEMANDIRIAN OBAT NASIONAL	3
961	Universitas Airlangga	Penelitian Dasar Unggulan Perguruan Tinggi	MASMIRA KURNIAWATI	0025037507	Peran Artificial Intelligence pada Marketing untuk Customer Targeting	3
962	Universitas Airlangga	Penelitian Dasar	MELANNY IKA SULISTYOWATY	0005058201	Pengembangan Tanaman Obat Asli Indonesia, Curcuma heyneana sebagai Novel Imunomodulator pada Rheumatoid Arthritis	2
963	Universitas Airlangga	Penelitian Disertasi Doktor	MERRYANA ADRIANI	0017055904	Aplikasi Diet seimbang G4G1L5 sebagai tatalaksana penurunan berat badan pada penderita obesitas	2
964	Universitas Airlangga	Penelitian Dasar	MIRA TRIHARINI	0024047905	PENGEMBANGAN MODEL PERAN KELUARGA BERBASIS INTENSI TERHADAP PENCEGAHAN ANEMIA KEHAMILAN DI SURABAYA	2
965	Universitas Airlangga	Penelitian Dasar Unggulan Perguruan Tinggi	MIRATUL KHASANAH	0004036705	Fabrikasi dan Aplikasi Sensor Berbasis Imprinted Zeolit Untuk Deteksi Potensiometrik Amitriptilin pada Sediaan Obat Antidepresan	2
966	Universitas Airlangga	Penelitian Dasar	MOCHAMAD ZAKKI FAHMI	0002078307	Pengoptimalan Nanopartikel Karbon dots Terdoping Boron dan Nitrogen Sebagai Agen Pengantar Obat Spesifik dan Penanda Sel Tumor	2

**LAPORAN TAHUNAN PENELITIAN**



**PENINGKATAN KUALITAS PELAYANAN ASFIKSIA NEONATORUM**

**TAHUN PERTAMA DARI RENCANA DUA TAHUN**

**Ketua Tim Peneliti**

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**SURABAYA**

**November 2021**

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Surabaya, 24 November 2021  
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## RINGKASAN

Angka kematian neonatal merupakan suatu standar (benchmark) dari perawatan yang diberikan terhadap neonatus dan status kesehatan. Jumlah bayi yang meninggal di usia neonatus di negara berkembang masih memprihatinkan dimana sekitar 4 juta bayi yang meninggal pada rentang usia tersebut. Indonesia sebagai negara berkembang pun juga menyumbangkan angka pada permasalahan sebagaimana diatas, dimana angka kematian neonatus yang hanya turun 3% per tiap tahun sejak 1990 hingga 2012 dan angka kematian neonatus mencapai 19 per 1.000 angka kelahiran hidup. Di seluruh dunia, dari sekian banyak penyebab kematian dari bayi selama periode neonatal adalah akibat prematuritas, sepsis, dan asfiksia yang mana juga masih merupakan penyebab utama kematian bayi baru lahir di negara berkembang. Untuk di RSUD Dr. Soetomo sendiri sebagai rumah sakit pusat rujukan tersier di provinsi Jawa Timur, asfiksia merupakan penyebab ketiga kematian neonatus menurut data tahunan yang diperoleh pada tahun 2019. Selain itu, penting juga untuk mengkaji ketersediaan sarana, akses, dan kualitas dari tenaga pertolongan persalinan penting untuk sehingga diharapkan dapat menurunkan angka kematian neonatus.

Prognosa pasien dan kualitas pelayanan sangat dipengaruhi oleh sumber daya tenaga kesehatan dan material berupa alat dan fasilitas. Untuk melakukan pelayanan yang optimal, tenaga kesehatan harus memiliki kesiapan, pengetahuan mengenai hak dan kewajibannya selama bekerja, serta mampu bersikap professional. Agar terwujudnya kesempurnaan dari pelayanan kepada pasien, modalitas diagnosa sederhana harus akurat untuk menggambarkan keadaan pasien sehingga dapat dilakukan pertimbangan keputusan yang cepat dan tepat. Terkait penanganan pada bayi baru lahir, mengingat keterbatasan dokter dan perawat dalam melakukan tanya jawab langsung kepada pasien, sehingga kehandalan tenaga medis dalam melakukan penilaian dan manajemen aktif sangatlah diperlukan.

Terdapat pokok permasalahan yang dapat menjadi “benang merah” terkait kematian neonatus akibat asfiksia. Faktor sumber daya manusia (Man) yakni beban kerja dan kapasitas kerja dari perawat serta pengetahuan tenaga medis akan resusitasi neonates. Selain itu, peralatan (Method) baik untuk metode penegakan asfiksia dengan skor APGAR yang terbilang subyektif serta peralatan yang seringkali tidak didapatkan pada tempat dengan fasilitas terbatas, maupun perlunya suatu metode estimasi denyut jantung yang praktis, non-subyektif, namun terjangkau di fasilitas terbatas, menjadi suatu permasalahan yang perlu diulas. Penelitian ini merupakan studi observasional pada multisenter menggunakan data primer dan sekunder. Data primer berupa hasil kuesioner yang menilai kesiapan, pengetahuan dan beban kerja yang dapat memengaruhi kinerja tenaga medis, hasil monitoring alat penunjang medis sederhana, serta hasil parameter pemeriksaan laboratorium sebagai penilaian asfiksia pada bayi. Adapun data sekunder yang digunakan adalah rekam medis elektronik dari bayi yang meninggal selama perawatan, ditinjau dari data demografis, riwayat penanganan dan fasilitas penunjang hidup yang diberolam. Dari data primer dan sekunder, akan dilakukan analisa deskriptif, studi korelatif, dan studi komparatif menggunakan analisa statistik.

Kata Kunci: Asfiksia; Kesiapan; Diagnosis; Inovasi; Kematian

## **PRAKATA**

Puji syukur kami panjatkan ke hadirat Tuhan Yang Maha Esa. Atas rahmat dan hidayah-Nya, penulis bisa menyelesaikan laporan tahunan 2021, untuk penelitian yang berjudul " Peningkatan Kualitas Pelayanan Asfiksia Neonatorum"

Penulis mengucapkan terimakasih kepada Kementrian Riset dan Teknologi / Badan Riset dan Inovasi Nasional (RISTEK/BRIN) yang telah memberikan pendanaan serta dukungan dalam pengerjaan penelitian ini. Tak lupa penulis juga mengucapkan terima kasih kepada seluruh peneliti yang telah terlibat membantu pengerjaan penelitian ini.

Hasil penelitian ini memberikan banyak informasi dan dukungan terhadap pengembangan panduan tatalaksana pada neonatus di Indonesia. Hasil penelitian ini juga akan di diseminasikan ke Jurnal Ilmiah untuk membantu perkembangan ilmu pengetahuan mengenai neonatus. Penulis akan terus berinovasi untuk memajukan penelitian dengan harapan kesehatan neonatus yang lebih baik dimasa yang akan datang.

Surabaya, 22 November 2021

Penulis



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## BAB 1. PENDAHULUAN

Masih memprihatinkan bahwa diantara 130 juta bayi yang lahir per tahunnya, lebih dari 4 juta diantaranya terdapat bayi baru lahir (neonatus) yang meninggal 1 dan hingga 99% di antaranya disumbangkan oleh negara-negara berkembang<sup>2</sup>. Penyebab utama tingginya angka kematian bayi baru lahir di dunia, termasuk negara berkembang, hingga kini adalah kelahiran premature, infeksi maupun sepsis, serta asfiksia<sup>2,3</sup>. Berdasarkan data laporan tahunan RSUD Dr. Soetomo tahun 2019, asfiksia merupakan penyebab utama ketiga kematian neonatal (Unpublished Data). Maka dari itu, penelitian ini akan berpusat terutama pada asfiksia.

Pada saat setelah lahir, bayi akan dinilai kebugarannya dengan menggunakan skor APGAR<sup>4</sup> untuk kemudian menentukan asfiksia dan perlunya tindakan resusitasi<sup>5</sup>. Indonesia menggunakan skor APGAR sebagai dasar diagnosis asfiksia sedangkan di negara-negara maju skor APGAR tidak dianjurkan lagi. American Academic of Pediatrics dan American College of Obstetrics and Gynecology menyarankan perlunya pemeriksaan penunjang lanjutan, meliputi analisis gas darah; penilaian disfungsi multi organ; dan skoring ensefalopati hipoksik iskemik (Thompson's)<sup>6</sup>. Karenanya, penelitian ini bertujuan untuk menilai korelasi skor APGAR dengan pemeriksaan penunjang lainnya.

Selanjutnya adalah evaluasi terhadap kesiapan tim dan alat serta kelengkapan riwayat antenatal dan riwayat keluarga untuk tindakan resusitasi bayi asfiksia di kamar bersalin. Tim yang mahir dengan pengetahuan serta terlengkapi alat yang memadai dalam memberikan resusitasi harus selalu siap dalam setiap kelahiran. Pada praktik resusitasi, selama penilaian denyut jantung lebih awal dengan auskultasi maupun EKG 3-lead. Di satu sisi, auskultasi berifat subyektif. Tapi di sisi lain, EKG 3-lead merupakan suatu instrument yang cukup mahal, sehingga tidak dimiliki oleh setiap fasilitas kesehatan. Fetal Doppler adalah alat yang digunakan untuk dapat mendengarkan deyt jantung janin. Alat ini praktis dan ekonomis untuk memberikan simulasi auditori dari denyut jantung. Oleh karena itu, penelitian ini ditujukan untuk menilai validasi Fetal Doppler untuk estimasi denyut jantung bayi di tempat dengan fasilitas terbatas.

Kematian bayi pada usia neonatus dapat mencerminkan bagaimana kualitas pelayanan selama periode antenatal maupun perawatan bayi baru lahir<sup>7</sup>. Kelalaian dalam perawatan (*missed care*) dapat mendeskripsikan gagalannya standar asuhan keperawatan, maupun ketidakseimbangan jumlah kapasitas pelayanan dan tenaga perawat<sup>8</sup>. Beban kerja sumber daya manusia memiliki implikasi terhadap kecenderungan *missed care*<sup>9</sup>. Penelitian ini karenanya juga dimaksudkan untuk mengevaluasi beban kerja perawat yang bertugas di unit perawatan neonatus terhadap luaran *missed care*.

Di sisi lain, seiring dengan kemajuan teknologi kedokteran, terdapat peningkatan survival rate pada bayi baru lahir. Namun demikian, terdapat juga risiko yang mungkin dapat timbul karena perawatan neonatal intensif, termasuk pada luaran masa depan neonatus yang memperoleh perawatan tersebut<sup>10</sup>. Oleh karena itu, neonatolog seringkali akan dihadapkan dengan keputusan yang berat untuk menghadapi bayi yang dalam kondisi akhir hayat. Sehubungan dengan hal

tersebut, penelitian yang kami ajukan ini juga akan ditujukan untuk memperoleh gambaran bagaimana bayi meninggal di unit perawatan neonatal intensif (NICU).

Penelitian ini sesuai dengan RPJM 2005-2022 dimana tantangan yang harus dihadapi oleh Indonesia adalah rendahnya kualitas kesehatan yang ditandai dengan tingginya angka kematian ibu dan bayi sehingga dengan peningkatan kualitas tatalaksana asfiksia (penyebab nomor satu kematian bayi) akan sangat membantu program pemerintah.

## BAB 2. TINJAUAN PUSTAKA

### Angka Kematian Bayi Baru Lahir

Angka kematian neonatal merupakan suatu standar (*benchmark*) dari perawatan yang diberikan terhadap neonatus dan status kesehatan. Angka kematian neonatus di negara berkembang masih terus menjadi permasalahan dimana hingga 4 juta bayi yang meninggal pada usia tersebut<sup>2</sup>. Menurut data oleh *World Health Organization* (WHO) negara-negara lainnya di Asia Tenggara rerata dengan angka kematian neonatus 19 per 1.000 kelahiran hidup<sup>1</sup>. Kematian selama periode neonatal adalah terbanyak dari keseluruhan kasus kematian pada bayi dan anak<sup>11</sup>. Asfiksia masih merupakan salah satu penyebab utama kematian bayi baru lahir.<sup>2,3</sup> Selain itu, ketersediaan sarana, akses, dan kesiapan dari tenaga penolong persalinan, kualitas perawatan penting untuk dapat mengurangi angka kematian bayi dengan asfiksia<sup>1,12</sup>.

### Asfiksia

Skor APGAR<sup>4</sup> secara umum digunakan sebagai salah satu metode untuk menilai kebugaran bayi pada saat lahir, hingga kemudian dapat memutuskan apakah bayi tersebut memang perlu resusitasi<sup>5</sup>. Sistem penilaian APGAR tersebut pada dasarnya terdiri atas lima parameter dengan masing-masing skor 0 hingga 2, yang ditentukan pada menit ke-1 dan menit ke-5 setelah bayi terlahir<sup>6</sup>. *Liaison Committee on Resuscitation* menganjurkan bahwa skor APGAR sebaiknya dibatasi hanya hingga menit ke-10 jika sudah tidak terdapat tanda kehidupan pada bayi, setelah itu resusitasi sebaiknya dihentikan<sup>13</sup>. *American Academic of Pediatrics* dan *American College of Obstetrics and Gynecology* menegaskan perlunya pemeriksaan penunjang lanjutan untuk menelusuri adanya: i) Asidemia; ii) Ensefalopati, dan iii) Disfungsi multi organ<sup>6</sup>. Penilaian skor APGAR saja tidak cukup karena meskipun skor APGAR bersifat numerik namun hanya skor penilaian *heartrate* saja yang bersifat objektif. sehingga penilaian skor APGAR secara keseluruhan bersifat subyektif (psikometrik)<sup>21</sup>.

### Resusitasi Neonatus

Tatalaksana asfiksia neonatorum di kamar bersalin adalah resusitasi. Resusitasi neonatal didefinisikan sebagai rangkaian intervensi pada saat lahir untuk mendukung pembentukan pernapasan dan sirkulasi. Setelah bayi lahir, kira-kira 4% hingga 10% bayi cukup bulan dan bayi premature memerlukan resusitasi<sup>14</sup>. Keberhasilan resusitasi pada satu jam pertama kehidupan akan menentukan luaran bayi dengan asfiksia. Salah satu parameter yang penting dalam keputusan melakukan resusitasi adalah penilaian *heartrate* bayi. Sesuai dengan rekomendasi The Consensus on Science and Treatment Recommendation (CoSTR) 2010, *heartrate* bayi diukur dengan metode auskultasi dengan stetoskop konvensional dengan penghitungan 10 detik dikalikan 6. Hal ini umum dilakukan oleh tenaga medis untuk menghemat waktu dan biaya bila dibandingkan dengan penggunaan *3-lead Electrocardiogram* (EKG *3-lead*) yang telah ditetapkan sebagai gold-standar di CoSTR 2015. Stetoskop konvensional merupakan suatu alat yang subjektif dan hanya bisa didengar oleh pengguna stetoskop tersebut. Hal ini menyebabkan penilaian *heartrate* bayi cenderung dilakukan hanya oleh 1 orang tenaga medis dan bergantung pada pengalaman dan pengetahuan tenaga medis tersebut. Jika bayi mengalami bradikardia (*heartrate* < 60) penilaian dengan menggunakan auskultasi sangatlah sulit dan memiliki risiko salah yang cukup besar jika dibandingkan dengan EKG *3-lead*. Masalahnya EKG *3-lead* merupakan suatu instrument yang

cukup mahal, sehingga tidak dimiliki oleh setiap fasilitas kesehatan. *Fetal doppler* merupakan suatu alat praktis dan ekonomis yang menggunakan efek *Doppler* untuk memberikan simulasi auditori dari *heartrate*. Beberapa model *fetal doppler* juga memiliki monitor untuk menunjukkan *heartrate* dalam denyut per menit (bpm). Penelitian di Tanzania secara acak dikatakan bahwa penggunaan *fetal doppler* untuk penentuan denyut jantung bayi akurat, dapat mengurangi kebutuhan resusitasi yang tidak perlu jika dibandingkan dengan stetoskop konvensional sehingga *fetal doppler* diharapkan dapat menjadi alternatif dalam mengukur *heartrate* bayi di fasilitas yang terbatas<sup>15,22</sup>.

### **Perawatan Bayi Asfiksia**

Kelalaian dalam perawatan atau *missed care* mulai dianggap sebagai suatu masalah signifikan yang tidak tampak dalam kinerja keperawatan<sup>8</sup>. Adapun masalah yang teridentifikasi terkait *missed care* adalah ambulasi, membolak-balikkan pasien, asuhan nutrisi, edukasi kesehatan, rencana pemulangan, dukungan emosional, kebersihan, dokumentasi, dan surveilans. Alasan dari *missed care* yang dilaporkan terutama jumlah staf yang kurang, waktu asuhan keperawatan yang tidak cukup, peralatan medis tidak memadai, ataupun kecenderungan menganggap ada tugas masing-masing.<sup>16</sup> Meskipun tidak begitu ekstensif, tren dari beban kerja perawat dan ketidakseimbangan kapasitas pelayanan dan unit perawat akan berdampak pada kualitas pelayanan. Selain faktor dari kelengkapan fasilitas rumah sakit seperti shift waktu yang terasa cukup pendek dalam memberikan asuhan keperawatan, data demografis seperti usia, latar belakang pendidikan, dan pengalaman kerja dari tenaga perawat juga dapat mempengaruhi kinerja perawat yang berujung pada semakin besarnya peluang resiko terjadinya *missed care*<sup>17</sup>.

Beban kerja perawat menggambarkan performa yang diperlukan untuk melakukan tindakan keperawatan dan umumnya dapat diukur menggunakan pengukuran objektif seperti *nurse-staffing ratio* ataupun *patient acuity score* berkorelasi dengan outcome pelayanan pada pasien<sup>9,18</sup>. Persepsi mengenai beban kerja atau *subjective workload* dapat bermanfaat sebagai indikator disfungsi sistem kerja yang memperluas pengertian mengenai efek beban kerja perawat terhadap pasien melebihi *staffing ratio*<sup>18</sup>. Maka dari itu, penilaian subjektivitas dan objektivitas mengenai beban kerja perawat memiliki nilai implikasi yang sama terhadap luaran masalah berupa kecenderungan *missed care*. Bagaimanapun juga, evaluasi mengenai hubungan antara beban kerja perawat dan *missed care* masih minim<sup>9</sup>.

### **Luaran Bayi Asfiksia**

Dikaitkan dengan prematuritas serta berbagai komplikasi yang menyertai seperti anomali kongenital dan asfiksia perinatal, kematian neonatal menjadi penyumbang utama pada keseluruhan kasus kematian pada bayi dan anak<sup>11</sup>. Kemajuan teknologi dalam kedokteran neonatologi terakhir telah diakui dapat meningkatkan *survival rate* pada bayi baru lahir<sup>10</sup>. Dalam bioetika modern, keputusan baik tidak memberikan maupun mencabut intervensi untuk pasien yang tidak stabil umumnya dianggap bertentangan dengan nilai hukum, meskipun secara moral masih dianggap sah<sup>19</sup>. Hal ini dapat menjadi data untuk perbandingan terhadap beberapa negara maju. Misalkan di negara Belanda, Sebagaimana didapatkan bahwa keputusan mengakhiri penunjang hidup ternyata seringkali mengawali kematian neonatus, yakni seperti tidak memberikan/mencabut alat penunjang hidup berdasarkan prediksi kematiannya<sup>20</sup>. Pada dasarnya kematian neonates dibagi



menjadi empat kategori yaitu neonates yang meninggal di kamar bersalin dan mendapatkan resusitasi, neonates yang meninggal di kamar bersalin dimana tidak dilakukan resusitasi, neonates yang meninggal di unit perawatan yang sedang dalam ventilasi mekanik, neonates yang meninggal di unit perawatan, diekstubasi atas alasan tertentu. Kategorisasi kematian neonatal tersebut akan memberikan gambaran bagaimana neonates itu meninggal sehingga penting dalam penentuan kebijakan untuk memperbaiki standard pelayanan, peningkatan peran etik-medikolegal dalam menilai intervensi yang akan diberikan pada bayi dengan kondisi akhir hayat.

### **BAB 3. TUJUAN DAN MANFAAT PENELITIAN**

#### **3.1 Tujuan dan Manfaat Penelitian Beban Kerja Perawat terhadap Kejadian *Missed Care***

Tujuan dari penelitian ini yakni untuk mengevaluasi beban kerja perawat NICU, frekuensi kelalaian perawatan yang terjadi, dan faktor yang menyebabkan kelalaian perawatan pada perawat NICU di negara berkembang. Data diperoleh dari 48 perawat yang bekerja di NICU RSUD dr. Soetomo, sebuah rumah sakit tersier pusat rujukan Indonesia Timur. Hipotesa kami yakni dengan beban kerja perawat yang lebih tinggi akan secara signifikan terkait dengan kejadian kelalaian perawatan yang lebih tinggi.

#### **3.2 Tujuan dan Manfaat Penelitian Kesiapan Tenaga Medis dan Rumah Sakit dalam Melakukan Resusitasi Neonatus**

Penelitian ini bertujuan untuk menganalisis kesiapan tenaga medis dan rumah sakit dalam melakukan resusitasi neonatus. Kuesioner dalam penelitian ini diharapkan dapat bermanfaat sebagai salah satu tes untuk mengevaluasi kesiapan tenaga medis dan rumah sakit dalam melakukan resusitasi neonatus

#### **3.3 Tujuan dan Manfaat Penelitian Kategorisasi Penyebab Kematian pada Periode Neonatal Dini di NICU**

Tujuan penelitian ini adalah untuk mengetahui penyebab dan faktor-faktor yang memengaruhi kematian neonatal dini di NICU dan ruang perawatan intermediate. Faktor-faktor yang mempengaruhi akan dikategorikan sebagai faktor neonatal, faktor maternal, faktor intra-partum, dan faktor pascapartum. Manfaat penelitian ini adalah untuk memberikan informasi ilmiah mengenai penyebab kematian neonatus dini beserta faktor-faktor yang memengaruhinya sebagai dasar untuk penelitian berikutnya, pengembangan ilmu pengetahuan, dan perbaikan tata laksana penanganan neonatus pada periode neonatal dini.

#### **3.4 Tujuan dan Manfaat Penelitian Perbandingan Auskultasi dan Fetal Doppler terhadap EKG 3-Lead dan Mengestimasi Denyut Jantung Bayi Baru Lahir**

Penelitian ini bertujuan untuk mengetahui akurasi dari auskultasi dan fetal doppler terhadap pembandingan ekg 3 lead sebagai standar dalam menetapkan denyut jantung bayi baru lahir. Manfaat dari penelitian ini adalah dengan adanya penelitian ini dapat mendukung penetapan alat yang digunakan untuk menilai denyut jantung bayi baru lahir yang cepat dan akurat dalam rangka membantu memaksimalkan penanganan terutama pada saat resusitasi bayi baru lahir.

## BAB 4. METODE PENELITIAN



Gambar 4.1 Road Map Penelitian

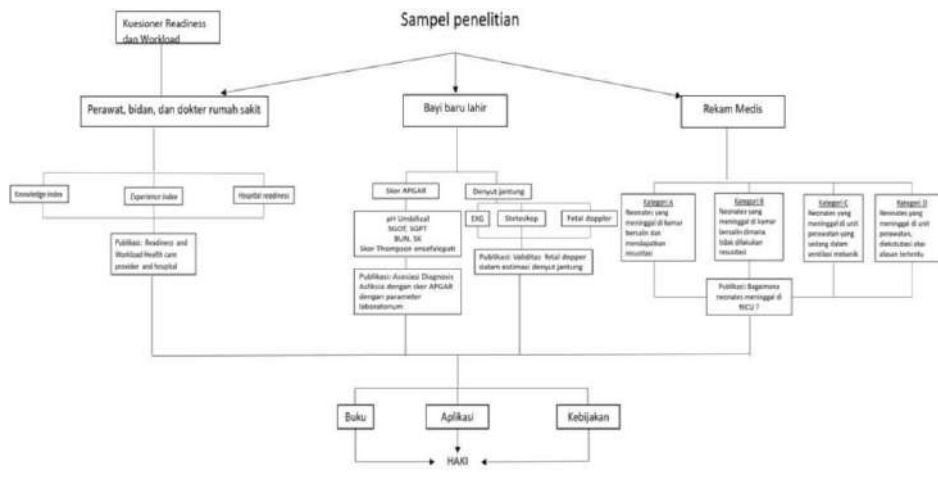
Penelitian ini merupakan penelitian observasional menggunakan data primer dan sekunder, Untuk menilai faktor individual seperti kesiapan dan beban kerja tenaga medis, akan diberikan Aplikasi atau kuesioner *google-form*, skala penilaian NASA TLX, dan *MISSCARE SURVEY*. Selanjutnya, kami juga melakukan analisa terhadap standar diagnostik menggunakan skor APGAR. Untuk validasi diagnosis asfiksia, kami akan melakukan berbagai macam indikator yakni pemeriksaan fungsi hati (ALT, AST), fungsi ginjal (ureum, kreatinin), skor THOMPSON untuk ensefalopati dan pH Umbilical. Untuk *fetal Doppler*, akan dibandingkan dengan penggunaan elektrokardiografi *3-lead* untuk membandingkan kemampuan dalam mengukur denyut jantung bayi. Data sekunder berdasarkan rekam medis mengenai data bayi baru lahir yang sudah meninggal (demografis seperti berat lahir, usia gestasi, waktu kematian, diagnosis utama penyebab kematian, dan intervensi penunjang hidup yang diberikan terutama pada bayi yang secara klinis tidak stabil), manajemen yang diberikan sebelum bayi meninggal, dan *infant acuity scores*.

Populasi penelitian adalah bayi baru lahir yang sedang dirawat, tenaga medis (dokter, bidan dan perawat). Teknik pengambilan sampel akan dilakukan menggunakan *cluster sampling* untuk menilai kesiapan tenaga medis dalam melakukan resusitasi neonatus serta beban kerja perawat dalam kejadian *missed care*. Teknik *purposive sampling* dilakukan dalam pengambilan data dari 4 kelompok kategori bayi yang meninggal untuk dikomparasikan. Teknik *total sampling* dilakukan untuk pengambilan sampel mengenai perbandingan akurasi standar *assessment* dan *diagnostic tool* dari berbagai macam indikator (skor APGAR, analisa gas darah, fungsi hati, fungsi ginjal, skor THOMPSON, *fetal Doppler*, elektrokardiografi *3-lead*).

Penelitian dilaksanakan di 5 rumah sakit *secondary* dan *tertiary care* (RSUD Dr. Soetomo; RSAL; RSUD Saiful Anwar; RS Bangil; RS Mojokerto). Penelitian akan dilakukan dalam kurun waktu satu tahun (Januari 2021 – Desember 2022). Data primer diambil dari kuisisioner yang disebar ke perawat, bidan, dan dokter umum (residen), observasi peralatan resusitasi neonatus di ruang rawat bayi dan NICU RSUD tempat penelitian, dan *record* mengenai modalitas standar *diagnostic* dan

*assessment tools*. Data sekunder berdasarkan rekam medis mengenai data bayi baru lahir yang sudah meninggal (demografis seperti berat lahir, usia gestasi, waktu kematian, diagnosis utama penyebab kematian, dan intervensi penunjang hidup yang diberikan terutama pada bayi yang secara klinis tidak stabil), manajemen yang diberikan sebelum bayi meninggal, dan *infant acuity scores*. Kemudian data primer dan sekunder akan disajikan dalam bentuk table dan dianalisis secara deksriptif, komparatif maupun korelasional dengan menggunakan SPSS 21.

Dr. Martono Tri Utomo, dr., Sp.A(K) adalah peneliti utama yang merupakan dokter spesialis anak konsultan neonatologi di RSUD Dr. Soetomo Surabaya. Peneliti bertugas dalam merancang desain penelitian, pengumpulan data, analisis dan interpretasi data. Peneliti juga melakukan revisi terhadap konsep-konsep penting dan memberikan persetujuan hasil karya penelitian untuk dipublikasi. Mahendra Tri Arif Sampurna, dr., Sp.A(K) adalah peneliti yang merupakan dokter spesialis anak konsultan neonatologi di RSUD Dr. Soetomo Surabaya. Peneliti bersama dengan peneiliti utama bertugas dalam merancang desain penelitian, pengumpulan data, analisis dan interpretasi data. Peneliti juga melakukan revisi terhadap konsep-konsep penting



Gambar 4.2 Alur Penelitian

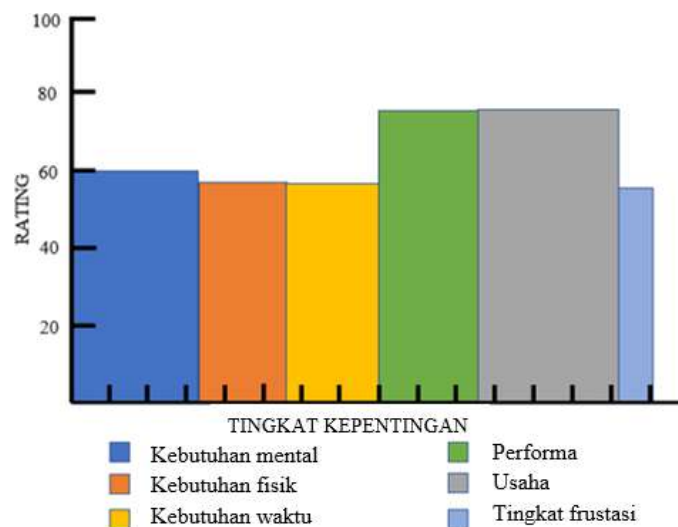
## BAB 5. HASIL DAN PEMBAHASAN

### 5.1 Hasil Pelaksanaan Penelitian Beban Kerja Perawat terhadap Kejadian *Missed Care*

#### Analisa Deskriptif

Dari 48 perawat yang berpartisipasi pada penelitian ini, semua berjenis kelamin perempuan (100%). Sampel penelitian dengan usia tertua yakni 56 tahun. Semua partisipan mengumpulkan survey setelah mendapatkan informasi yang cukup terkait pertanyaan di kuesioner dengan tidak ada data yang hilang (0%). Mayoritas perawat yang berpartisipasi dalam penelitian ini merupakan lulusan D3 (72.9%), dan hanya sebagian kecil yang merupakan lulusan S2 (2.1%). (Tabel 5.1)

Dari bagian pertama kuesioner, skor NASA-TLX dapat diukur untuk menentukan beban kerja perawat. Mean dari skor total beban kerja adalah 68, dengan skor tertinggi 96 (range 42-96; median 67.33). (Tabel 5.1) Distribusi dari 6 komponen NASA-TLX dapat dilihat pada gambar 1. Lebar dari grafik komponen NASA-TLX menunjukkan tingkat kepentingan dari masing-masing komponen (weight), sedangkan tinggi dari grafik menunjukkan rating/nilai dari masing-masing komponen. Dari semua komponen beban kerja, usaha memiliki tingkat kepentingan tertinggi dengan mean 3.625 serta tingkat rating/nilai tertinggi dengan mean 75.83. Sedangkan tingkat frustrasi memiliki tingkat kepentingan (mean 0.89) dan tingkat rating/nilai (mean 55.42) terendah.



Gambar 5.1 Distribusi skor beban kerja NASA-TLX

Dari survey yang dilakukan, 44 (perawat (91.67%)) melaporkan telah melakukan minimal 1 kelalaian dari item perawatan neonatal dasar. Jumlah kelalaian perawatan memiliki rentang mulai dari 4.76% hingga 61.9%, dengan nilai mean 27.92% dan nilai median 23.81%. Distribusi dari kelalaian perawatan dapat dilihat pada table 2. Dari laporan yang diperoleh, mayoritas dari kelalaian perawatan terjadi jarang ataupun terkadang. Dari semua item perawatan neonatus dasar, perawatan yang paling sering terabaikan yakni memberikan dukungan emosional pada orang tua dan/atau keluarga pasien (33 [68.75%]) dan melakukan pemeriksaan kadar gula darah bedside sesuai yang diperintahkan (33 [68.75%]). Sedangkan item perawatan yang paling jarang terlewat

yakni melakukan assessment pasien setiap shift (1 [2.1%]), melakukan perawatan mulut (2 [4.2%]) dan mencuci tangan (2 [4.2%]).

Penyebab dari kelalaian perawatan terbagi menjadi 3 bagian, yakni faktor komunikasi, faktor sumber daya material, dan faktor sumber daya tenaga kesehatan (Tabel 5.3). Pada faktor komunikasi, masalah yang terjadi secara umum jarang terjadi atau kadang terjadi. Masalah tersering pada faktor komunikasi yakni ketegangan atau gangguan komunikasi dengan departemen lain (30 [62.5%]). Masalah pada komunikasi yang paling jarang terjadi yakni operan yang tidak memadai setiap shift (5 [10.42%]). Pada faktor sumber daya material, mayoritas masalah juga jarang atau kadang terjadi. Masalah persediaan/peralatan tidak berfungsi dengan baik saat dibutuhkan (35 [72.72%]) merupakan permasalahan yang paling sering terjadi terkait sumber daya material. Jika dibandingkan dengan faktor komunikasi dan sumber daya material, permasalahan pada sumber daya tenaga kesehatan memiliki frekuensi tertinggi. Secara keseluruhan, permasalahan pada faktor sumber daya tenaga kesehatan memiliki frekuensi kadang atau sering terjadi. Dari semua masalah pada faktor ini, masalah situasi pasien yang mendesak ketika terjadi perburukan kondisi (47 [92.92%]) merupakan masalah yang paling sering terjadi, diikuti dengan permasalahan peningkatan jumlah pasien secara melonjak (46 [95.83%]).

#### **Beban kerja dan Kelalaian perawatan**

Hubungan antara beban kerja dengan tingkat kejadian kelalaian perawatan dapat dilihat pada tabel 5.4. Korelasi antara total beban kerja dengan total kelalaian perawatan yang terjadi dianalisa dengan menggunakan korelasi Pearson, sedangkan korelasi antara total beban kerja dengan masing-masing item kelalaian perawatan di analisa dengan korelasi Spearman. Dari semua item kelalaian perawatan, hanya kelalaian pada perawatan ambulasi yang memiliki hubungan signifikan dengan total beban kerja (Koefisien korelasi 0.329;  $p=0.022$ ). 21 item kelalaian perawatan yang lain tidak memiliki korelasi statistik yang signifikan dengan total beban kerja.

<b>Tabel 5.1 Karakteristik Perawat dan Beban kerja</b>		
<b>Karakteristik</b>		<b>N(%)/ mean <math>\pm</math> SD (Min - Max)</b>
Usia		40.33 $\pm$ 7.68 (26 - 56)
Tingkat Pendidikan	D3	35 (72.9)
	D4	1 (2.1)
	S1	11 (22.9)
	S2	1 (2.1)
Skor total beban kerja NASA-TLX		68.36 $\pm$ 11.83 (42 - 96) <sup>a</sup>
Singkatan: NASA-TLX, National Aeronautics and Space Administration Task Load Index.		
<sup>a</sup> Rentang skor dari 0 (rendah) to 100 (tinggi)		

<b>Tabel 5.2 Distribusi Kelalaian Perawatan</b>					
<b>Item Kelalaian Perawatan</b>	<b>Respon N (%)</b>				
	<b>Jarang Lalai</b>	<b>Kadang Lalai</b>	<b>Sering Lalai</b>	<b>Selalu Lalai</b>	<b>Lalai</b>
Ambulasi tiga kali sehari atau sesuai jadwal	11 (22.9)	9 (18.8)	7 (14.6)	0 (0)	27 (56.25)
Membalikkan pasien setiap 2 jam	12 (25)	1 (2.1)	0 (0)	0 (0)	13 (27.1)
Memberi makanan hangat pada pasien	4 (8.3)	2 (4.2)	0 (0)	0 (0)	6 (12.5)
Menyiapkan makanan untuk pasien	3 (6.3)	4 (8.3)	2 (4.2)	3 (6.3)	12 (25)
Pengobatan diberikan dalam waktu 30 menit sebelum atau setelah waktu yang dijadwalkan	7 (14.6)	10 (20.8)	3 (8.3)	0 (0)	20 (41.67)
Tanda vital dinilai sesuai jadwal	3 (6.3)	0 (0)	0 (0)	0 (0)	3 (6.3)
Memantau asupan / keluaran nutrisi	1 (2.1)	1 (2.1)	0 (0)	0 (0)	2 (4.2)
Dokumentasi lengkap dari semua data yang diperlukan	3 (6.3)	0 (0)	0 (0)	0 (0)	3 (6.3)
Mengajarkan pasien tentang prosedur, tes, dan studi diagnostik lainnya	8 (16.7)	14 (29.2)	5 (10.4)	3 (6.3)	30 (62.5)
Dukungan emosional untuk pasien dan / atau keluarga	15 (31.3)	13 (27.1)	5 (10.4)	0 (0)	33 (68.75)
Memandikan pasien	2 (4.2)	0 (0)	1 (2.1)	0 (0)	3 (6.25)
Merawat mulut pasien	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (4.2)
Cuci tangan rutin	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (4.2)
Mengajarkan pasien tentang rencana perawatannya setelah pulang dan kapan harus kontrol	6 (12.5)	3 (6.3)	3 (6.3)	0 (0)	12 (25)
Pemantauan glukosa di samping tempat tidur pada kasus tertentu	7 (14.5)	18 (37.5)	7 (14.6)	1 (2.1)	33 (68.75)

Penilaian pasien dilakukan setiap shift	1 (2.1)	0 (0)	0 (0)	0 (0)	1 (2.1)
Evaluasi lokasi jalur IV / sentral sesuai dengan kebijakan rumah sakit	5 (10.4)	0 (0)	0 (0)	0 (0)	5 (10.4)
Respon terhadap lampu panggilan dimulai dalam 5 menit	7 (14.6)	1 (2.1)	0 (0)	1 (2.1)	9 (18.75)
Permintaan pengobatan PRN ditindaklanjuti dalam 15 menit	9 (18.8)	5 (10.4)	0 (0)	0 (0)	14 (29.17)
Pengkajian efektivitas pengobatan	7 (14.6)	2 (4.2)	2 (4.2)	1 (2.1)	12 (25)
Membantu kebutuhan toilet dalam waktu 5 menit dari permintaan	9 (18.8)	5 (10.4)	2 (4.2)	0 (0)	16 (33.33)
Singkatan: IV, intravenous; PRN, pro re nata.					

**Tabel 5.3 Frekuensi Penyebab Kelalaian Perawatan**

Penyebab Kelalaian Perawatan	Respon N (%)					Frekuensi <sup>a</sup>
	Tidak pernah terjadi	Jarang terjadi	Kadnag terjadi	Sering terjadi	Selalu terjadi	
A. Faktor Komunikasi						
Metode pembagian tugas yang tidak seimbang	40 (83.3)	5 (10.4)	3 (6.3)	0 (0)	0 (0)	8 (16.67)
Operan yang tidak memadai setiap shift	43 (89.6)	4 (8.3)	0 (0)	0 (0)	1 (2.1)	5 (10.42)
Departemen lain tidak memberikan perawatan yang dibutuhkan (misalnya, terapi fisik tidak berjalan dengan baik)	26 (54.2)	3 (6.3)	13 (27.1)	3 (6.3)	3 (6.3)	22 (45.83)



Kurangnya dukungan dari anggota tim	29 (60.4)	7 (14.6)	10 (20.8)	0 (0)	2 (4.2)	19 (39.58)
Ketegangan atau gangguan komunikasi dengan departemen lain	18 (37.5)	12 (25)	12 (25)	4 (8.3)	2 (4.2)	30 (62.5)
Ketegangan atau gangguan komunikasi dalam tim perawat	27 (56.3)	10 (20.8)	8 (16.7)	0 (0)	3 (6.3)	21 (43.75)
Ketegangan atau gangguan komunikasi dengan staf medis	26 (54.2)	12 (25)	7 (14.6)	0 (0)	3 (6.3)	22 (45.83)
Asisten perawat tidak mengkomunikasikan bahwa perawatan belum dilakukan	31 (64.6)	8 (16.7)	7 (14.6)	0 (0)	2 (4.2)	17 (35.42)
Teknisi unit tidak tersedia	27 (56.3)	1 (2.1)	15 (31.3)	2 (4.2)	3 (6.3)	21 (43.75)
<b>B. Faktor Sumber Daya Material</b>						
Obat tidak tersedia bila diperlukan	19 (39.6)	10 (20.8)	15 (31.3)	0 (0)	4 (8.3)	29 (60.42)
Persediaan / peralatan tidak tersedia saat dibutuhkan	17 (35.4)	12 (25)	16 (33.3)	0 (0)	3 (6.3)	31 (64.58)
Persediaan / peralatan tidak berfungsi dengan baik saat dibutuhkan	13 (27.1)	7 (14.6)	24 (50)	2 (4.2)	2 (4.2)	35 (72.92)
<b>C. Faktor Sumber Daya Tenaga Kerja</b>						
Jumlah staf tidak memadai	7 (14.6)	10 (20.8)	18 (37.5)	9 (18.8)	4 (8.3)	41 (85.42)
Situasi pasien yang mendesak ketika terjadi perburukan kondisi	1 (2.1)	7 (14.6)	20 (41.7)	16 (33.3)	4 (8.3)	47 (97.92)
Peningkatan jumlah	2 (4.2)	4 (8.3)	22 (45.8)	13 (27.1)	7 (14.6)	46 (95.83)

pasien secara melonjak						
Jumlah personel pembantu yang tidak memadai (misalnya, asisten perawat, teknisi, sekretaris unit, dll.)	17 (35.4)	3 (6.3)	16 (33.3)	7 (14.6)	5 (10.4)	31 (64.58)
Note: <sup>a</sup> Frequency = Rarely + Occasionally + Frequently + Always Happened						

**Tabel 5.4 Korelasi Total Beban kerja dengan Kelalaian Perawatan**

<b>Outcome</b>	<b>Total Beban kerja diukur dengan NASA-TLX, Koefisien korelasi (p value)</b>
Total kelalaian perawatan	0.092 (0.536)
Ambulasi tiga kali sehari atau sesuai jadwal	0.329 (0.022)*
Membalikkan pasien setiap 2 jam	0.212 (0.149)
Memberi makanan hangat pada pasien	0.159 (0.280)
Menyiapkan makanan untuk pasien	0.245 (0.093)
Pengobatan diberikan dalam waktu 30 menit sebelum atau setelah waktu yang dijadwalkan	0.156 (0.291)
Tanda vital dinilai sesuai jadwal	-0.096 (0.515)
Memantau asupan / keluaran nutrisi	-0.184 (0.209)
Dokumentasi lengkap dari semua data yang diperlukan	0.071 (0.629)
Mengajarkan pasien tentang prosedur, tes, dan studi diagnostik lainnya	-0.093 (0.528)
Dukungan emosional untuk pasien dan / atau keluarga	-0.019 (0.895)
Memandikan pasien	0.093 (0.528)
Merawat mulut pasien	-0.087 (0.558)
Cuci tangan rutin	0.132 (0.372)

Mengajarkan pasien tentang rencana perawatannya setelah pulang dan kapan harus kontrol	-0.226 (0.123)
Pemantauan glukosa di samping tempat tidur pada kasus tertentu	-0.123 (0.404)
Penilaian pasien dilakukan setiap shift	0.184 (0.210)
Evaluasi lokasi jalur IV / sentral sesuai dengan kebijakan rumah sakit	-0.167 (0.255)
Respon terhadap lampu panggilan dimulai dalam 5 menit	-0.019 (0.897)
Permintaan pengobatan PRN ditindaklanjuti dalam 15 menit	-0.015 (0.920)
Pengkajian efektivitas pengobatan	0.047 (0.752)
Membantu kebutuhan toilet dalam waktu 5 menit dari permintaan	-0.128 (0.387)
Singkatan: IV, intravenous; NASA-TLX, National Aeronautics and Space Administration Task Load Index; PRN, pro re nata. * $p < 0.05$ , $\alpha$ terkoreksi untuk tingkat kesalahan	

## 5.2 Hasil Pelaksanaan Penelitian Kesiapan Tenaga Medis dan Rumah Sakit dalam Melakukan Resusitasi Neonatus

Hasil pada penelitian ini dibagi menjadi dua yaitu data tingkat pengetahuan subjek terhadap cara resusitasi neonatus (kuesioner 1) dan data pengalaman resusitasi pada neonatus (kuesioner 2). Data demografi subjek kuesioner 1 dapat dilihat pada tabel 5.5. Subjek penelitian pada kuesioner 1 sebagian besar bekerja di rumah sakit tipe A yaitu sebanyak 79 (64.2%) dengan rentang usia rata-rata 30 tahun. Tingkat partisipasi pada profesi bidan (46/123; 37.4) dan perawat (41/123; 33.3) hampir sama dan didominasi oleh perempuan (112/123; 91.1%). Rerata lama bekerja subjek penelitian adalah 8.34 tahun dengan status pekerjaan terbanyak adalah peserta didik (67/123; 54.5%) dari rentang tahun 2015 sampai dengan 2021. Tingkat pendidikan tenaga medis pada kuesioner 1 terbanyak adalah D3 (67/123; 54.5) dan S1 (54/123; 43.9). Jumlah subjek yang bekerja di unit ruang kerja level 1 dan level 3 sama banyak yaitu 55 (44.7) subjek. Unit kerja yang termasuk dalam level 1 adalah IGD, ruang bayi dan ruang neonatus, level 2 adalah RKL&Couve dan perinatologi, level 3 adalah NICU/PICU.

<b>Tabel 5.5 Karakteristik Subjek Tingkat Pengetahuan</b>					
<b>Karakteristik</b>		<b>Jumlah</b>		<b>Mean</b>	<b>Standar Deviasi</b>
		<b>N</b>	<b>%</b>		
<b>Asal Rumah Sakit</b>	Tipe A	79	64.2		
	Tipe B	12	12		
	Tipe C	20	16.3		
	Tipe D	12	9.8		
<b>Jenis Kelamin</b>	Laki-Laki	11	8.9	0.91	0.287
	Perempuan	112	91.1		
<b>Usia</b>	<30	69	56.1	30.02	7.8
	30-40	42	34.1		
	40-50	10	8.1		
	>50	2	1.6		
<b>Pendidikan Terakhir</b>	D3	67	54.5		
	S1	54	43.9		
	S2	1	0.8		
	S3	1	0.8		
<b>Jenis Profesi</b>	Residen/PPDS anak	27	22		
	Bidan	46	37.4		
	Perawat	41	33.3		
	Dokter umum	9	7.3		
<b>Lama Bekerja (Tahun)</b>	<1 Tahun	14	11.4	8.34	7.9
	1-5 Tahun	26	21.1		
	5-10 Tahun	17	13.8		
	10-15 Tahun	11	8.9		
	15-20 Tahun	6	4.9		
	>20 Tahun	9	7.3		
<b>Status Kepegawaian</b>	Pegawai Tetap	34	27.6		
	Pegawai Kontrak	21	17.1		
	Peserta Didik	67	54.5		
<b>Tahun Mulai Pendidikan (PPDS)</b>	2015	2	7.4		
	2016	6	22.2		
	2017	4	14.8		
	2018	2	7.4		
	2019	6	22.2		
	2021	7	25.9		
<b>Unit Kerja / Ruang Rawat</b>	Level 1	55	44.7		
	Level 2	13	10.6		
	Level 3	55	44.7		

Tabel 5.6 menunjukkan proporsi jawaban benar dan salah pada subjek secara keseluruhan. Subjek penelitian sebagian besar salah menilai pernyataan pada pernyataan yang melibatkan waktu perlakuan kompresi dada dan ventilasi tekanan positif, jumlah denyut jantung pada bayi, diagnosis bayi apnea primer atau sekunder, waktu pemberian oksigen dan tujuan penentuan APGAR Score.

No.	Pertanyaan	Jawaban	
		Benar N(%)	Salah N(%)
1	Ukuran ET Tube yang sesuai untuk bayi dengan berat 2.800 gram adalah 2,5mm	90 (73.2)	33 (26.8)
2	Ketika kompresi dada, sternum harus terdorong masuk sedalam 1,2 hingga 1,9cm	72 (58.5)	51 (41.5)
3	Pemberian epinefrin sebaiknya segera dimulai bila HR<60 atau 0, dengan atau tanpa VTP sebelumnya	30 (24.4)	93 (75.6)
4	Kompresi dada dan ventilasi dilakukan setidaknya 60 detik sebelum evaluasi HR kedua dilakukan.	96 (78.1)	27 (21.2)
5	ET tube atau kateter suction ukuran 6-F atau 8-F dapat digunakan untuk menghisap meconium dari trakea	87 (70.7)	36 (29.3)
6	Menunda pengeringan bayi yang depresi nafas bisa dilakukan untuk memulai usaha resusitasi.	98 (79.7)	25 (20.3)
7	VTP pada neonates dilakukan dengan kecepatan 30-40 kali per menit	60 (48.8)	63 (51.2)
8	Kateter orogastric sebaiknya dipasang bila bayi memerlukan ventilasi menggunakan balon dan sungkup selama lebih dari beberapa menit.	71 (58.8)	52 (42.3)
9	Kompresi dada sebaiknya dimulai hanya jika HR dibawah 60 kali per menit dan telah dilakukan ventilasi tekanan positif selama 15-30 detik	16 (13)	108 (87)
10	Pada bayi yang menunjukkan usaha nafas, seharusnya denyut jantung minimal 100 kali per menit	11 (9)	112 (91)
11	Respon yang buruk terhadap tindakan resusitasi merupakan tanda hypovolemia pada neonatus	92 (74.8)	31 (25.2)
12	Ketika memberikan oksigenasi kepada neonates dengan masker atau selang oksigen, flowmeter harus diatur pada dosis 5 lpm	54 (43.9)	69 (56.1)
13	Volume balon sungkup untuk neonatus tidak boleh melebihi 750ml	111 (90.2)	12 (9.8)
14	Ketika menghisap sekret saat intubasi, tekanan suction tidak boleh melebihi -100mmHg	116 (94.3)	7 (5.7)
15	Hidung neonatus sebaiknya disuction dahulu sebelum mulut	58 (47.2)	65 (52.8)
16	Setiap percobaan intubasi harus dibatasi tidak lebih dari 30 detik untuk meminimalisir hipoksia	115 (93.5)	8 (6.5)

17	Pada neonatus, depresi pernafasan karena narkotika kebanyakan disebabkan oleh karena pemberian narkotika kepada ibu bayi dalam waktu 4 jam sebelum persalinan	109 (88.6)	14 (11.4)
18	Mengembangnya dada dan adanya suara nafas pada kedua lapang paru bisa digunakan sebagai indicator dari ventilasi yang adekuat	120 (97.6)	3 (2.4)
19	Ketika bayi tidak bernafas saat lahir, sangat mudah untuk menentukan bayi tersebut apnea primer atau sekunder	40 (32.5)	83 (67.5)
20	Kompresi dada selalu disertai dengan pemberian ventilasi tekanan positif secara terkoordinasi	34 (27.6)	89 (72.4)
21	Ketika terjadi apnea sekunder, pemberian oksigen dan stimulasi biasanya akan dapat memicu pernafasan	28 (22.8)	95 (77.2)
22	Apabila denyut jantung bayi >100 dan dada mengembang, namun bayi tetap menunjukkan gejala sianosis sentral, tindakan yang paling tepat adalah memulai ventilasi tekanan positif dengan balon dan sungkup, atau ETT	82 (66.7)	41 (33.3)
23	Penempatan ET tube dapat dikonfirmasi dengan mendengarkan suara nafas pada kedua lapang paru.	120 (97.6)	3 (2.4)
24	Skor APGAR digunakan untuk menentukan kapan memulai resusitasi dan tujuan dari resusitasi	35 (28.5)	88 (71.5)
25	Perlengkapan resusitasi yang lengkap sebaiknya tersedia di kamar bersalin hanya ketika ada indikasi kebutuhan resusitasi	114 (92.7)	9 (7.3)

Nilai dari hasil pengisian kuesioner tiap subjek di total dan dikelompokkan menjadi 4 kategori yaitu nilai yaitu <10, 10-15, 15-20, dan >20 (Tabel 5.7). Tiap profesi dan unit kerja kemudian dilihat hubungannya dengan menggunakan uji Pearson's chi-square terhadap kategori nilai. Didapatkan hasil signifikan antara unit kerja dan jenis profesi terhadap tingkat pengetahuan ( $P < .05$ ).

		Bidan N= 46	Perawat N= 41	Dokter Umum N= 9	PPDS/Residen Anak N= 27	P value*
<b>Level 1</b>	<10					0.01
	10-15	39 (84.8)	3 (7.3)			
	15-20	7 (15.2)	6 (14.6)			
	>20					
<b>Level 2</b>	<10					0.01
	10-15		2 (4.9)	5 (55.6)		
	15-20		2 (4.9)	4 (44.4)		
	>20					
<b>Level 3</b>	<10					0.01
	10-15		19 (46.3)		8 (29.6)	
	15-20		9 (22)		18 (66.7)	
	>20				1 (3.7)	

Table disajikan dalam besaran angka dan (persentase)

\**P* value adalah hasil dari uji Pearson's chi-square antara unit ruang kerja dan profesi terhadap tingkat pengetahuan subjek penelitian.

Kriteria tingkat kesiapan yang kedua adalah pengalaman tenaga kesehatan melakukan resusitasi pada neonatus. Total jumlah subjek inklusi pada kuesioner 2 adalah sebanyak 70 subjek. Pada Tabel 5.8 disajikan karakteristik subjek yang mengisi kuesioner untuk menentukan pengalaman tenaga kesehatan dalam melakukan resusitasi pada neonatus.

Berdasarkan Tabel 5.8, sebagian besar subjek bekerja di rumah sakit tipe A (34/70; 48.6%) dengan jenis kelamin terbanyak adalah perempuan (60/70; 85.7%). Rerata usia subjek penelitian adalah 33 tahun dengan latar belakang pendidikan terakhir terbanyak adalah S1 (42/70; 60%). Jumlah profesi tenaga medis terbanyak adalah perawat (32;45.7%) dengan unit kerja terbanyak adalah level 3 (43/70; 61.4%).

<b>Karakteristik</b>		<b>Jumlah</b>		<b>Mean</b>	<b>Standar Deviasi</b>
		<b>N</b>	<b>%</b>		
<b>Asal Rumah Sakit</b>	Tipe A	34	48.6		
	Tipe B	15	21.4		
	Tipe C	14	20		
	Tipe D	7	10		
<b>Jenis Kelamin</b>	Perempuan	60	85.7	33	6.6
	Laki-laki	10	14.3		
<b>Usia (tahun)</b>	<30	27	38.6		
	30-40	34	48.6		
	40-50	8	11.4		
	>50	1	1.4		
<b>Pendidikan Terakhir</b>	D3	26	37.1		
	S1	42	60		
	S2	2	2.9		
<b>Profesi Tenaga Medis</b>	PPDS Anak	23	32.9		
	Dokter Umum	9	12.9		
	Perawat	32	45.7		
	Bidan	6	8.6		
<b>Lama bekerja (tahun)</b>	<1	13	18.6	7.6	7.2
	1-5	24	34.3		
	5-10	15	21.4		
	10-15	7	10		
	15-20	4	5.7		
	>20	7	10		

<b>Status Kepegawaian</b>	Pegawai Tetap	28	40		
	Pegawai Kontrak	15	21.4		
	Peserta Didik	26	37.1		
<b>Tahun Mulai pendidikan spesialis</b>	2015	2	8.7		
	2016	4	17.4		
	2017	4	17.4		
	2018	1	4.3		
	2019	5	21.7		
	2020	1	4.3		
	2021	6	26.1		
<b>Ruang Rawat / Unit Kerja</b>	Level 1	15	21.4		
	Level 2	12	17.1		
	Level 3	43	61.4		

Subjek penelitian diminta untuk menilai setiap pernyataan berdasarkan pengalaman pribadi dengan mencentang angka 1 jika jarang melakukan dan angka 5 jika sering melakukan serta angka di antaranya. Pada Tabel 5.9 disajikan data jawaban pengalaman keseluruhan subjek terhadap tiap-tiap tindakan pada saat resusitasi neonatus.

Berdasarkan Tabel 5.9, sebagian besar subjek (28/70; 40%) jarang melakukan perbaan terhadap denyut nadi neonatus melalui tali pusat. Subjek juga menjawab jarang melakukan penghisapan endotrakea pada bayi dengan ketuban mekoneal (25/70; 35.7%) dan melakukan atau membantu intubasi endotracheal (19/70; 27.1%). Subjek jarang melakukan/ membantu pemasangan kateter umbilical (24/70; 34.3%), mengambil darah melalui kateter vena umbilical (33/70; 47.1%), dan memberikan obat/cairan melalui kateter umbilical (25/70; 35.7%). Subjek juga menjawab jarang melakukan interpretasi hasil gas darah neonatus (27/70; 38.6%).

No	Pertanyaan	Jawaban n (%)				
		1	2	3	4	5
1.	Memberikan perawatan kepada neonatus setelah persalinan	11 (15.7)	6 (8.6)	9 (12.9)	9 (12.9)	35 (50)
2.	Mengeringkan, memposisikan, dan <i>suction</i> neonatus	9 (12.9)	5 (7.1)	8 (11.4)	15 (21.4)	33 (47.1)
3.	Melakukan <i>suction</i> pada neonatus dengan kateter penghisap	9 (12.9)	6 (8.6)	9 (12.9)	16 (22.9)	30 (42.9)
4.	Mendengarkan denyut jantung neonatus dengan stetoskop	5 (7.1)	6 (8.6)	8 (11.4)	22 (31.4)	29 (41.4)
5.	Meraba denyut nadi melalui tali pusat	28 (40)	11 (15.7)	19 (27.1)	8 (11.4)	4 (5.7)



6.	Menyalakan terlebih dahulu <i>infant warmer</i> sebelum persalinan dimulai	7 (10)	3 (4.3)	4 (5.7)	8 (11.4)	48 (68.6)
7.	Menilai APGAR Score pada bayi baru lahir yang bugar	4 (5.7)	4 (5.7)	9 (12.9)	11 (15.7)	42 (60)
8.	Menilai APGAR Score pada bayi baru lahir yang sakit	9 (12.9)	6 (8.6)	10 (14.3)	15 (21.4)	30 (42.9)
9.	Memasang orogastric tube pada neonatus	14 (20)	3 (4.3)	10 (14.3)	9 (12.9)	34 (48.6)
10.	Melakukan penghisapan jalan nafas pada neonatus dengan mesin suction	10 (14.3)	3 (4.3)	6 (8.6)	18 (25.7)	33 (47.1)
11.	Melakukan penghisapan endotrakea pada bayi dengan ketuban mekoneal	25 (35.7)	8 (11.4)	13 (18.6)	12 (17.1)	12 (17.1)
12.	Melakukan VTP dengan balon dan sungkup	10 (14.3)	2 (2.9)	16 (22.9)	21 (30)	21 (30)
13.	Melakukan atau membantu intubasi endotracheal	19 (27.1)	14 (20)	12 (17.1)	9 (12.9)	16 (22.9)
14.	Melakukan kompresi dada pada neonatus	12 (17.1)	6 (8.6)	19 (27.1)	15 (21.4)	18 (25.7)
15.	Melakukan/membantu pemasangan kateter umbilikal	24 (34.3)	9 (12.9)	17 (24.3)	7 (10)	13 (18.6)
16.	Mengambil darah melalui kateter vena umbilikal	33 (47.1)	4 (5.7)	16 (22.9)	6 (8.6)	11 (15.7)
17.	Memberikan obat/cairan melalui kateter umbilikal	25 (35.7)	9 (12.9)	9 (12.9)	9 (12.9)	18 (25.7)
18.	Menginterpretasikan kadar gula darah neonatus	9 (12.9)	7 (10)	11 (15.7)	16 (22.9)	27 (38.6)
19.	Menginterpretasi hasil gas darah neonatus	27 (38.6)	9 (12.9)	12 (17.1)	10 (14.3)	12 (17.1)
20.	Berkomunikasi dengan keluarga saat resusitasi	11 (15.7)	6 (8.6)	15 (21.4)	13 (18.6)	25 (35.7)
21.	Berkomunikasi dengan keluarga setelah resusitasi	6 (8.6)	8 (11.4)	8 (11.4)	13 (18.6)	35 (50)
22.	Memberikan dukungan emosional kepada keluarga saat resusitasi	9 (12.9)	5 (7.1)	12 (17.1)	18 (25.7)	26 (37.1)
23.	Memberikan dukungan emosional kepada keluarga saat resusitasi	7 (10)	3 (4.3)	9 (12.9)	21 (30)	30 (42.9)

Karena tingginya angka mortalitas neonatus di negara berkembang, penelitian ini sangat penting untuk menentukan sumber dari salah satu permasalahan pada perawatan neonatus. Selain itu, kami juga menemukan masih sedikitnya penelitian terkait beban kerja dan kelalaian perawatan di NICU terutama pada negara berkembang. Pada penelitian ini, kami mendapati nilai mean dari total beban

kerja perawat NICU yang diukur dengan skor NASA-TLX termasuk dalam kategori tinggi. Komponen beban kerja terbesar yakni usaha. Usaha yang lebih tinggi berarti pekerjaan harus dilakukan dengan lebih keras untuk mencapai tingkat performa yang diperlukan. Hasil yang sama juga didapatkan pada penelitian sebelumnya terkait beban kerja yang dilakukan di *Intensive Care Unit* di sebuah rumah sakit di Aceh, Indonesia. Usaha menjadi komponen terbesar pada beban kerja kemungkinan terkait dengan lingkungan NICU yang memiliki tekanan tinggi untuk melakukan monitoring dan memberikan perawatan pada neonatus yang memerlukan perawatan intensif. Sedangkan komponen beban kerja dengan nilai terkecil yakni tingkat frustrasi. Tingkat frustrasi dianggap sebagai komponen yang paling tidak berperan pada beban kerja kemungkinan terkait dengan tingginya tekanan beban kerja pada dimensi lain sehingga perawat NICU tidak memiliki kesempatan untuk memikirkan terkait kondisi lingkungan kerjanya yang terkait dengan tingkat frustrasi. Selain itu, perawat yang memiliki pengalaman kerja lebih Panjang cenderung sudah lebih beradaptasi dengan lingkungan kerja dan tekanan pekerjaannya sehingga memiliki tingkat frustrasi yang lebih rendah. (1,2)

Dari semua perawatan neonatus dasar yang dilakukan di NICU, perawatan yang paling sering mengalami kejadian lalai yakni memberikan dukungan emosional kepada orang tua dan/atau keluarga pasien serta melakukan monitoring kadar glukosa darah bedside sesuai perintah. Sedangkan perawatan yang paling jarang mengalami kejadian lalai yakni assessment pasien pada setiap shift, perawatan mulut dan mencuci tangan. Penemuan ini sesuai dengan hasil pada studi yang telah dilakukan sebelumnya, dimana pemberian dukungan emosional masih merupakan salah satu item perawatan yang sering terjadi kelalaian, akan tetapi pada penelitian ini tingkat kelalaian yang terjadi lebih tinggi jika dibandingkan dengan penelitian sebelumnya (3,4) Tekanan kerja yang tinggi di NICU menyebabkan perawat memiliki waktu yang lebih sedikit untuk melakukan pekerjaan mereka, sehingga terkadang beberapa perawatan menjadi tertunda atau tidak dilakukan, terutama perawatan yang dianggap “kurang penting” seperti jenis pelayanan psiko-sosial termasuk pemberian dukungan emosional pada orang tua dan/atau keluarga dari neonatus. (5,6) Terkait monitoring kadar glukosa darah bedside, hasil pada penelitian ini berkebalikan dengan studi yang telah dilakukan sebelumnya, dimana perawatan ini termasuk dalam jenis perawatan neonatus dasar yang jarang terlewatkan. (4,7) Kejadian hipoglikemia pada neonatus merupakan masalah metabolik tersering yang terjadi pada neonatus, sehingga skrining kejadian hipoglikemia pada neonatus, terutama bayi berisiko, merupakan hal yang sangat penting. Kadar glukosa darah yang sangat rendah dapat menimbulkan beberapa masalah yang dapat mengancam jiwa seperti apnea, iritabilitas, letargi, kejang, dan bahkan dapat menimbulkan kerusakan otak. (8) Kegagalan untuk melakukan monitoring kadar glukosa darah bedside seperti yang diperintahkan dapat menimbulkan permasalahan berbahaya pada neonatus, oleh karena itu sangatlah penting untuk meningkatkan kewaspadaan terkait konsekuensi dari kelalaian perawatan serta penyediaan alat monitoring kadar glukosa darah bedside yang lebih baik untuk menurunkan morbiditas pada neonatus. Sebaliknya, 3 item perawatan yang paling jarang terlewatkan kemungkinan terkait dengan fakta bahwa kelalaian pada item perawatan tersebut dapat terdeteksi dengan mudah dan adanya audit rutin terkait item perawatan tersebut pada unit keperawatan. (20) Selain itu, upaya peningkatan kualitas rumah sakit menyebabkan terbentuknya protokol-protokol termasuk *hand hygiene*, sehingga perawat akan lebih memprioritaskan beberapa perawatan terkait dengan adanya insentif ataupun disinsentif. (4)

Berkebalikan dengan hipotesa kami, pada penelitian ini tidak terdapat korelasi statistik yang signifikan antara total beban kerja dengan frekuensi kelalaian perawatan. Tubbs-Cooley, et al (2019) menemukan hal yang berkebalikan pada studinya, dimana total beban kerja subjektif yang diukur dengan skor NASA-TLX memiliki hubungan korelasi yang signifikan secara statistik dengan semua item kelalaian perawatan. Hal ini kemungkinan disebabkan karena bias yang terjadi pada proses pengumpulan data pada penelitian kami, dimana partisipan penelitian gagal untuk mengingat kembali kelalaian perawatan yang telah mereka lakukan secara akurat. Selain itu faktor usia dan edukasi, serta lama pengalaman bekerja yang tidak kami evaluasi juga dapat mempengaruhi hasil.

Untuk faktor lain yang mempengaruhi kejadian kelalaian perawatan, faktor sumber daya tenaga kerja merupakan permasalahan yang paling sering terjadi, diikuti dengan masalah sumber daya material dan masalah komunikasi. Penyebab yang paling sering terjadi yakni situasi pasien yang mendesak ketika terjadi perburukan kondisi dan peningkatan jumlah pasien secara melonjak. Penemuan ini sejalan dengan beberapa studi lain yang telah dilakukan sebelumnya. (3,4,6,7) Meskipun faktor sumber daya tenaga kerja memegang proporsi terbesar sebagai contributor dalam kelalaian perawatan, intervensi yang secara eksklusif terfokus pada sumber daya tenaga kerja mungkin tidak akan cukup untuk menurunkan kejadian kelalaian perawatan. (9) Intervensi untuk mencapai kerja sama tim yang baik, komunikasi yang jelas, penurunan beban kerja berlebih, pembagian pekerjaan yang lebih baik, serta pengaturan dalam tingkat keparahan serta jumlah pasien yang terkontrol diperlukan untuk dapat meminimalkan kejadian kelalaian perawatan. (7)

Dengan meningkatkan Kerjasama pada tim NICU memungkinkan tercapainya tingkat keamanan pasien yang lebih baik, termasuk control infeksi yang lebih baik, serta menurunkan kejadian error dalam memberikan perawatan intensif pada neonatus, seperti pada resusitasi neonatus. (10,11) Terkait faktor sumber daya material, masalah tersering yang terjadi yakni persediaan/peralatan yang tidak berfungsi dengan baik saat dibutuhkan. Sebuah studi oleh Perry dan Malkin (2011) menemukan bahwa terdapat sekitar 38.3% peralatan medis yang rusak di negara berkembang. Penyebab utama dari masalah ini yakni kurangnya pelatihan dalam merawat dan menggunakan alat, manajemen teknologi kesehatan yang buruk, serta infrastruktur yang buruk. Intervensi yang adekuat diperlukan untuk menyelesaikan masalah-masalah ini sehingga dapat meningkatkan efektifitas dari perawat yang bekerja di NICU. (13)

### **Tingkat Pengetahuan dan Pengalaman Resusitasi Neonatus Tenaga Medis**

Tingkat pengetahuan dan pengalaman tinggi mengenai resusitasi neonatus yang dimiliki oleh tenaga kesehatan adalah kunci dari keberhasilan tim resusitasi (15). Menurut American Academy of Pediatrics (AAP), unit kerja dalam perawatan neonatus dibagi ke dalam empat level yaitu level 1 sampai dengan level 4. Namun, dalam penelitian ini subjek penelitian hanya bekerja pada unit perawatan neonatus level 1 sampai dengan level 3. Pada unit kerja level 1 resusitasi neonatus biasanya dilakukan untuk menstabilisasi kondisi bayi cukup bulan dengan kondisi stabil secara fisiologis sehingga semua tenaga medis dapat bekerja di unit ini seperti bidan, perawat, dokter dan dokter spesialis. Unit kerja level 2 membutuhkan keterampilan lebih tinggi dibandingkan dengan level 1 karena melakukan stabilisasi pada bayi prematur dan bayi cukup bulan yang sakit secara

fisiologis sehingga diperlukan tenaga medis dengan keterampilan lebih tinggi seperti dokter spesialis neonatology dan perawat neonatolog. Sedangkan pada level 3 perlu dilakukan stabilisasi bayi yang berkelanjutan sehingga diperlukan dokter anestesi pediatri, dokter bedah anak, dan perawat neonatology (16). Dalam penelitian ini tenaga kesehatan yang bekerja pada level 1 adalah bidan dan perawat, pada level 2 adalah perawat dan dokter umum, serta pada level 3 adalah Residen/PPDS anak.

Penelitian ini menguji tingkat pengetahuan dan pengalaman tenaga kesehatan mengenai resusitasi neonatus diuji dan dilihat korelasinya terhadap level unit kerja dan jenis profesi dan didapatkan hasil yang signifikan ( $P < .05$ ). Pada unit kerja level 1, sebagian besar bidan (39/46; 84.8%) menilai pernyataan dengan benar dalam skala nilai 10-15. Hal ini terjadi karena pada unit kerja level 1 melakukan resusitasi pada neonatus tanpa komplikasi sehingga resusitasi yang dilakukan tidak terlalu rumit. Jika membandingkan antara profesi bidan dan perawat pada unit kerja level 1, sebagian besar perawat (6/41; 14.6%) memiliki nilai yang lebih tinggi dibandingkan bidan yaitu pada skala 15-20. Namun, sebagian besar perawat pada unit kerja level 3 (19/41; 46.3%) justru memiliki rentang nilai yang cukup rendah dibandingkan dengan perawat yang bekerja pada unit kerja level 1. Pada unit kerja level 2, profesi dokter dan perawat memiliki rentang nilai yang terkesan sama dari total masing-masing profesi yang bekerja di unit yang sama yaitu pada rentang nilai 10-15 dan 15-20. Pada unit kerja level 3, sebagian besar Residen/PPDS Anak (18/27; 66.7%) memiliki rentang nilai lebih tinggi (15-20) dibandingkan dengan perawat (19/41; 46.3%; 10-15).

Tingkat pengetahuan tenaga medis yang rendah mengenai resusitasi neonatus tentu akan memengaruhi tingkat keberhasilan tim resusitasi dalam melakukan stabilisasi. Hal ini tentu menjadi salah satu pertimbangan untuk melakukan pelatihan tambahan kepada perawat yang bekerja di unit kerja level 3 mengingat resusitasi yang dilakukan pada unit kerja level 3 memerlukan tindakan yang berkelanjutan. Pelatihan tambahan menggunakan *The Newborn Resuscitation Manual of the UK* dengan design pelatihan meliputi kuliah, demonstrasi skill dan skenario menggunakan manekin dan alat-alat resusitasi telah terbukti dapat meningkatkan tingkat pengetahuan perawat, dokter, dokter residen, dan dokter spesialis di Northern Nigeria sehingga pengadaannya perlu menjadi fokus utama saat ini agar dapat meningkatkan kinerja tenaga medis dalam pengambilan keputusan langkah-langkah resusitasi neonatus (14). Hal ini dikarenakan pengalaman personal tenaga medis dalam melakukan tiap langkah resusitasi neonatus juga merupakan indikator yang penting dalam menentukan kesiapan rumah sakit untuk melakukan resusitasi pada neonatus (16). Pelatihan langkah-langkah melakukan resusitasi perlu dilakukan secara cermat terutama pada langkah perabaan denyut nadi melalui tali pusat, penghisapan endotrakea pada bayi dengan ketuban mekoneal, intubasi endotracheal, pemasangan kateter umbilikal, pengambilan darah melalui kateter vena umbilikal, pemberian obat/cairan melalui kateter umbilikal dan cara interpretasi hasil gas darah neonatus. Langkah-langkah tersebut memerlukan pelatihan lebih intens karena sangat jarang dilakukan oleh sebagian besar subjek penelitian pada penelitian ini (Tabel 5.9).

Intubasi endotracheal pada neonatus sangat jarang dilakukan karena tingkat kesulitan yang tinggi jika dilakukan oleh pemula. Sekalipun terlatih melakukan, terkadang tenaga medis masih perlu melakukan beberapa kali percobaan agar intubasi dapat masuk ke trachea neonatus yang cukup

kecil (17). Hal lain seperti pemasangan kateter umbilikal, pengambilan darah dan pemberian obat melalui vena umbilikal juga sangat jarang dilakukan karena perlunya keterampilan khusus pada tenaga medis terlatih agar tidak menjadi faktor resiko sepsis, terutama pada bayi prematur (18). Perlu adanya evaluasi mengenai langkah tersebut terkait kurangnya paparan subjek terhadap langkah-langkah tersebut atau ketidaktahuan subjek dalam melakukan hal tersebut secara benar sehingga mengurangi kepercayaan diri subjek dalam melakukan langkah tersebut.

## BAB 6. RENCANA TAHAPAN BERIKUTNYA

No.	Judul Artikel	Jurnal yang dituju	Quartil	Tahun capaian	Status ketercapaian
1.	Beban kerja perawat terhadap kejadian <i>missed care</i>	BMC Pediatrics	Q 1	2022	Proses submit artikel
2.	Kesiapan rumah sakit resusitasi neonatus	Pediatric Anesthesia	Q2	2022	Proses submit artikel
3.	Studi komparasi kategorisasi kematian neonatus	Journal of Paediatrics and Child Health	Q2	2022	Proses tabulasi dan analisis data
4.	Perbandingan akurasi estimasi denyut jantung bayi antara <i>Fetal Doppler</i> , auskultasi, dan Elektrokardiogram 3-lead	Pediatrics Cardiology	Q2	2022	Proses etik
5.	Validasi skor APGAR dengan analisa gas darah <i>cord blood</i> ; penilaian disfungsi multi-organ; dan Skor <i>Thompson's</i>	International Journal of Neonatal Screening	Q2	2022	-

## **BAB 7. KESIMPULAN DAN SARAN**

Penelitian kami mendapatkan bahwa komponen usaha merupakan komponen dengan nilai terbesar pada beban kerja perawat, dan secara keseluruhan total beban kerja dari perawat NICU termasuk dalam kategori tinggi. Kelalaian perawatan yang paling sering terjadi yakni pemberian dukungan emosional pada orang tua dan/atau keluarga pasien serta melakukan monitoring glukosa darah bedside sesuai dengan perintah. Dari keseluruhan faktor penyebab kelalaian perawatan, faktor sumber daya tenaga kerja merupakan faktor yang paling penting, terutama masalah situasi pasien yang mendesak ketika terjadi perburukan kondisi dan peningkatan jumlah pasien secara melonjak. Meskipun begitu, intervensi yang hanya terfokus pada faktor tenaga kerja mungkin tidak cukup untuk menyelesaikan permasalahan kelalaian perawatan. Diperlukan intervensi untuk mencapai kerja sama tim yang lebih baik, komunikasi yang jelas serta perawatan teknologi dan peralatan medis yang lebih baik sehingga dapat mencapai lingkungan kerja yang lebih baik untuk meningkatkan efektifitas dari perawat yang bekerja di NICU.

Selain itu, kesiapan tenaga medis melalui indikator tingkat pengetahuan dan pengalaman dalam melakukan tindakan resusitasi neonatus sangat penting untuk keberhasilan tindakan resusitasi. Dalam penelitian ini, ditemukan bahwa tingkat pengetahuan perawat yang bekerja pada unit level yang lebih tinggi tidak selaras. Tambahan pelatihan berupa pelatihan skill tenaga medis juga sangat diperlukan karena masih ada beberapa langkah-langkah resusitasi yang sangat jarang dilakukan oleh tenaga medis.

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## LAMPIRAN

### Lampiran 1. Etik Penelitian

**PEMERINTAH PROPINSI JAWA TIMUR**  
**RUMAH SAKIT UMUM DAERAH Dr. SOETOMO**  
**KOMITE ETIK PENELITIAN KESEHATAN**  
 Jl. Mayjen Prof. Dr. Moestopo No. 8-9, Telp. 031-5501071-5501073, Fax. 031-5501164  
 SURABAYA 60296

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**SURAT EXEMPTION**  
 (" LETTER OF EXEMPTION ")

Ref. No. : 0335/LOB/301.A.2/II/2021

Judul Protokol Penelitian : Improving Neonatal Asphyxia Management in Dr. Soetomo General Academic Hospital

Dokumen yang disetujui : 0530/105/1/E/2021 (versi 2)

Tanggal terbit : 8 Februari 2021


Berlaku sampai : 8 Februari 2022

Peneliti Utama : Dr. Martono Tri Utomo, dr., Sp.A (K)


Peneliti Lain : 1. Mabendra Tri Arif Sampurna, dr., Sp.A (K)  
 2. Ivan Angelo Albright, dr  
 3. Dr. Risa Erika, dr., Sp.A (K)  
 4. Agus Hariyanto, dr., Sp.A (K)  
 5. Kartika Darma Handayani, dr., Sp.A (K)  
 6. Dina Angelika, dr., Sp.A (K)  
 7. Prof. Fook-Choo Cheah, M.D., Ph.D.  
 8. Nadise Natasha Iskandar

Instansi/Tempat Penelitian : RSUD Dr. Soetomo

Komite Etik Penelitian Kesehatan RSUD Dr Soetomo menyatakan bahwa dokumen diatas sesuai dengan The Office for Human Research Protections (OHRP) dikawah persyaratan the U.S. Department of Health and Human Services (HHS) Regulasi 45 CFR bagian 46 untuk exempt review.



**Dr. Pius Haniandito dr., Sp.An., KIC**  
Ketua Panel 2



**Dr. Damayanti Tindah dr., Sp.KFER(K)**  
Sekretaris Panel 2

## Lampiran 2. Nota Izin Penelitian

**PEMERINTAH PROVINSI JAWA TIMUR**  
**RUMAH SAKIT UMUM DAERAH DOKTER SOETOMO SURABAYA**  
**BIDANG PENELITIAN DAN PENGEMBANGAN**  
 Jl. Prof. Dr. Moestopo No. 6-8 Tlp. 031-5501073, 5501164  
**S U R A B A Y A**

**NOTA DINAS**

Kepada Yth : 1. Kepala Bidang Pemasaran Dan Rekam Medik  
 2.  
 3.  
 RSUD Dr. Soetomo Surabaya  
 Dari : Kepala Bidang Penelitian dan Pengembangan  
 Nomor : 070/ 779 / 301.4.2/Litb/ VIII /2021  
 Tanggal : 09 Agustus 2021  
 Sifat : Penting  
 Lampiran : 1 Eksploitasi  
 Perihal : Permohonan ijin penelitian

Dengan ini kami mohon ijin penelitian atas nama :

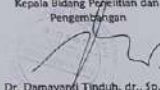
Nadine Natasha Iskandar

Untuk dapat melaksanakan permohonan ijin penelitian di unit kerja / bagian Saudara dengan Judul :

**Improving Neonatorum Asphyxia Management in Dr. Soetomo General Academic Hospital**

Apabila dapat divetui kami mengharapkan jawaban Saudara dalam waktu tidak terlalu lama guna proses administrasi lebih lanjut. Sebagai bahan pertimbangan Saudara, bersama ini kami lampirkan foto copy *letter of exemption*.

Atas perhatian dan kerjasamanya kami sampaikan terima kasih.



Kepala Bidang Penelitian dan Pengembangan  
  
**Dr. Damayanti Tinduh, dr., Sp.KFR(K)**  
 Pembina  
 NIP. 19710112 200604 2 031

Tembusan :Yth

1. Direktur RSUD Dr. Soetomo (sebagai laporan)
2. Direktur Pendidikan Profesi dan Penelitian
3. Anlip

## Lampiran 3. Submit Artikel pada BMC Pediatrics

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**BMC Pediatrics - Receipt of Manuscript 'Nurse Workload, Missed...'**  

**External** **Inbox** x

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**BMC Pediatrics** Tue, Nov 23, 10:16 PM (2 days ago) ☆ ↶ ⋮  
to me ▾

Ref: Submission ID a3da2034-efc-4cab-8824-1ca2e2db1212

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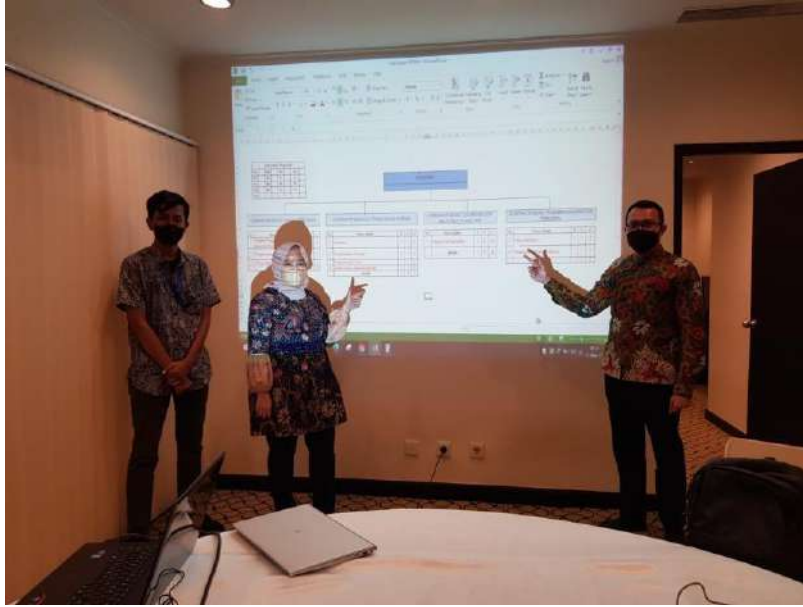
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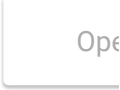
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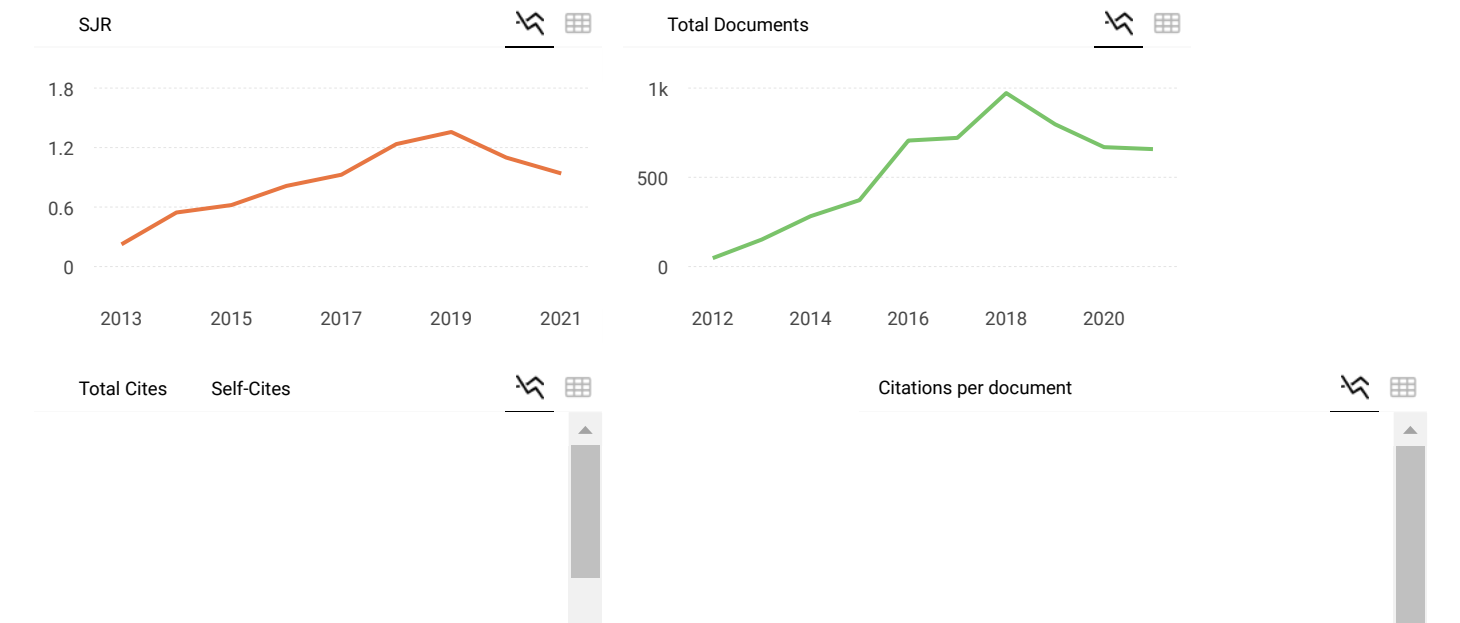
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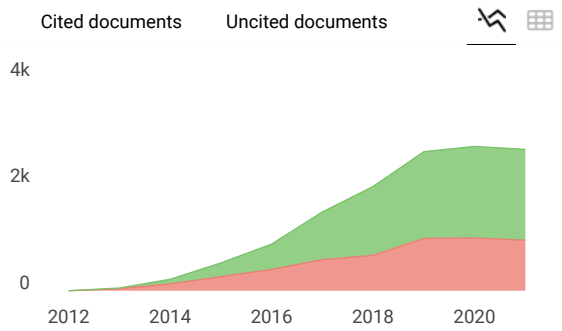
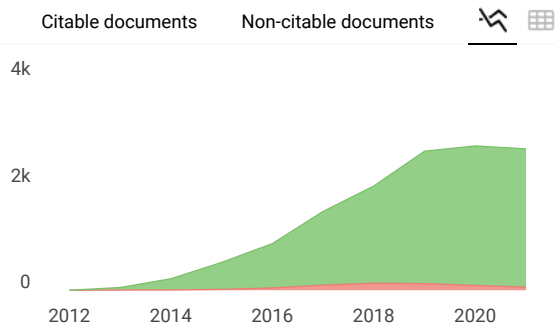
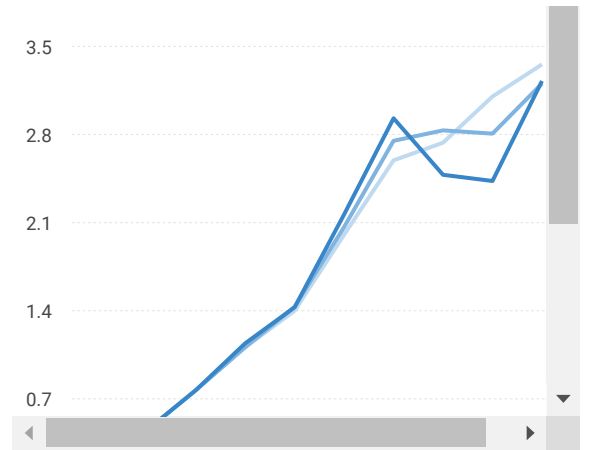
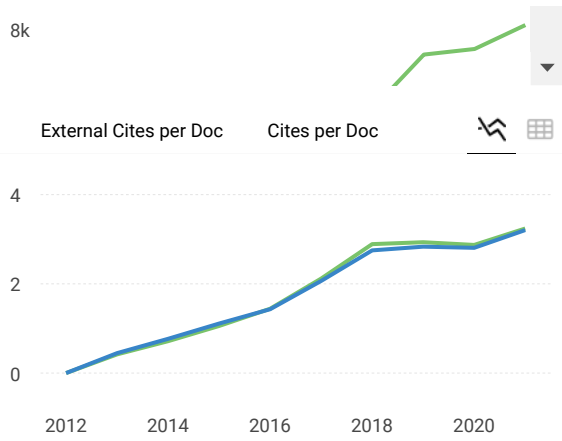
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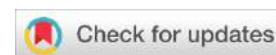


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## RESEARCH ARTICLE

# Nurse workload, missed nursing care, and the contributing factors in the Neonatal Intensive Care Unit in a limited resource setting: A case from Indonesia [version 1; peer review: awaiting peer review]

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## Open Peer Review

**Approval Status** AWAITING PEER REVIEW

Any reports and responses or comments on the article can be found at the end of the article.

## Abstract

**Background:** Nurses who are in charge of the Neonatal Intensive Care Units (NICUs) have a different workload and work assignments compared to other units. Evidence suggests that higher nurse workloads will increase the risk of missed nursing care. Missed nursing care in the NICU will eventually worsen the neonatal prognosis. This is a major problem in developing countries, which currently still have a high neonatal mortality rate.

**Methods:** This was a cross sectional study using questionnaires to collect data from 48 nurses who work in Dr. Soetomo Hospital NICU from April 15<sup>th</sup> 2021 to July 25<sup>th</sup> 2021. The collected data was then processed with descriptive statistics, meanwhile the correlation between workload with missed nursing care was analyzed with Pearson and Spearman correlation.

**Results:** The total mean of NICU nurse workload score according to the NASA-TLX (National Aeronautics and Space Administration Task Load Index) was 68.36, indicating a moderate overall workload, with effort as the highest component. Overall, 91.67% of the nurses had missed at least 1 out of 21 basic neonatal nursing care components. Labor resource factor was the most frequent missed nursing care

factor, in which urgent patient situations were the most frequent problem. There was no significant correlation between the total nurse workload and the frequency of any missed nursing care ( $P=0.536$ ).

**Conclusions:** Effort was the biggest component of the NICU nurse total workload. The most frequently missed nursing care was giving emotional support for the patient's parents and/or family. Labor resource factor was the most frequent problem which caused missed nursing care. However, there is no statistically significant correlation between the total workload with the frequency of missed nursing care.

### Keywords

nurse workload, missed nursing care, nurse, neonate, NICU nurse

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## Introduction

Neonatal period, which is the first 28 days of life, is an extremely important period for children's survival. With the majority of neonatal deaths happening in the first week of life, newborns are facing many high risks of dying in this vulnerable period (<https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality>). Globally, there were around 2.4 million neonatal deaths in 2019, in which a high portion of it comes from low and lower middle-income countries, including Indonesia (around 60 thousand neonatal deaths in 2019) (<https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality>). Several contributing factors are preterm birth, infections and birth defects (<https://data.unicef.org/topic/child-survival/neonatal-mortality>).

The Neonatal Intensive Care Unit (NICU) is a specialized area in the hospital that provides advanced technologies and trained healthcare professionals for the treatment of high-risk newborns from prematurity, low birth weight, and specific health condition (respiratory problem, heart problem, infection, or birth defects) (<https://www.stanfordchildrens.org/en/topic/default?id=the-neonatal-intensive-care-unit-nicu-90-P02389>). According to a study conducted from 2009 until 2010 in Nepal, as a developing country, among the aforementioned conditions, respiratory distress was shown as the most common neonatal condition which led to NICU admission.<sup>1</sup> Despite being expensive and not easily accessible, the NICU is an extremely important unit that can not only save lives but can also help in increasing the survival rates for neonates.

The NICU as a setting with higher nurse-to-patient ratio has a different nurse workload and assignment compared to other units. Although most NICU infants are low-acuity, around 12% of the high acuity infants will need higher staffing ratio (around 0.95) compared to lower acuity infants (around 0.33). This nurse shortage, which will increase the nurse workload, can lead to care being delayed or omitted which will increase infant mortality.<sup>2,3</sup> A study conducted in a Midwestern academic medical center showed that the workload of NICU nurses based on the subjective workload rating of National Aeronautics and Space Administration Task Load Index (NASA-TLX), was significantly associated with missed nursing care.<sup>4</sup> Missed care is theorized to be linked with poor work environments and staffing.<sup>4-6</sup>

Higher quality care for infants and their parents in the NICU will provide them with better outcomes. Life threatening conditions, such as neonatal infections, can be prevented with a high quality of care, including appropriate hand hygiene and central-line care practice.<sup>7-10</sup> Preparation of families for discharge given by the nurse is crucial to ensure that parents could manage their infant's care after being discharged from the NICU. High quality care for infants and their parents in the NICU will provide them with better outcomes.<sup>11</sup> In contrast, misses in nurse care will cause poor outcomes for infants hospitalized in the NICU which were already at high risk.<sup>6,12</sup> Although neonatal care has improved considerably in developing countries, there are still several unresolved challenges remaining when compared to developed countries.<sup>13</sup> Poor infrastructure, resource limitation, and a lack of referral systems are several problems faced by the developing countries in providing optimal neonatal care.<sup>13,14</sup> The prognosis for infants admitted to the NICU in developing countries remains poor, with limited evidence indicating a mortality rate between 0.2 to 64.4%.<sup>15</sup> This high mortality rate is related to a higher prevalence of newborn infections in developing countries compared with developed countries.<sup>16-18</sup> A systematic literature review by Kermani *et al.* (2020) identified 90 risk factors associated with neonatal mortality in the NICU, which are categorized into 25 maternal factors, 59 neonatal factors, and 6 organizational factors.<sup>19</sup> Several factors associated with neonatal mortality include scarcity of trained health care personnel, overcrowding of the neonatal units, late onset and slow advance of feeding, use of formula instead of breastfeeding, failure to comply with handwashing recommendations, and excessive use of antibiotics.<sup>18,20,21</sup> With the majority of the neonatal deaths coming from the developing country, there is an urgency to implement the appropriate interventions to reduce the number of missed nursing care in the NICU. Therefore, there is a need to inform the implementation of such interventions, especially regarding the current existing missed NICU nursing care and factors associated with it in a limited resource setting.

This study aims to evaluate the NICU nurse workload, the frequency of missed NICU nursing care, and the other contributing factors associated with missed NICU nursing care in developing countries by analyzing data obtained from 48 nurses working in Dr. Soetomo General Hospital, a central referral hospital in East Java, Indonesia. We hypothesized that nurses with higher subjective workload (NASA-TLX) would significantly miss more care.

## Methods

### Ethical considerations

Ethical clearance was granted from IRB Dr. Soetomo General Hospital by letter of exemption 0335/LOE/301.4.2/II/2021. Written informed consent was obtained from participating nurses.

### Study design, data, and sample

This was a cross-sectional study using questionnaires to collect data from the nurses working in the Neonatal Intensive Care Unit (NICU) of Dr. Soetomo General Hospital, a central referral hospital in East Java, Indonesia. Registered NICU

nurses were defined if they had completed unit orientation, had provided direct patient care, and were actively employed in the NICU. All of the defined NICU nurses were found to be eligible to participate in our study. Hence, a total sampling frame was determined to establish the final study size of 48 nurses. Participants were recruited via direct solicitations in the department of pediatrics of Dr. Soetomo General Hospital. The study participants, split into three groups, were gathered in a room to be given the information regarding the study and the instruction on how to fill in the [NASA-TLX questionnaires](#). Then the questionnaires were given to participants by a trained research assistant after enough information had been given.

The questionnaires were split into three sections, which were: a) nurse workload, b) frequency of miss in nurse care, and c) factor contributing to miss care. Nurse workload was assessed using the paper version of the NASA-TLX.<sup>22,23</sup> The questions were translated to Indonesian language and went through several processes of validity testing, including the testing to clarify whether there were any mistranslation or loss of meaning during the translation, testing for the questions clarity, and testing for any bias regarding the translated questions. There were six components measured by the NASA-TLX, which consists of mental demands, physical demands, time pressure, effort to accomplish goals, performance, and frustration. Total workload scores were then calculated by the sum of the adjusted rating (weight  $\times$  raw rating) divided by 15. The scores for overall workload scores ranged from 0 (low) to 100 (high). The second and third part of the questionnaire were taken from the MISSCARE Survey-English.<sup>24</sup> Its content validity index was 0.87 with test-retest validity ( $r=0.88$ ,  $p<0.001$ ). The survey consists of 21 items of essential neonatal nursing care and the reason for missed nursing care divided into three categories (communication, material resources, and labor resources). The MISSCARE Survey was translated into Indonesian language through several processes to ensure no compromise in any loss of meaning during the translation. The translated survey was subsequently disseminated to an expert panel in order to evaluate the internal validity. The survey was also disseminated to 10 nurses for external face validity to evaluate their interpretation and understanding of each item. Missed nursing care was assessed by asking nurses to report the omission frequency of the 21 neonatal nursing care practices. The frequency was divided based on a Likert type scale, which are: always missed, frequently missed, occasionally missed, rarely missed, and never missed. The responses were then dichotomized into missed or not missed for each of the 21 items. In the third part, the nurses were asked to assess and chose the reasons for missed nursing care in their unit among the presented options in the questionnaire. For each question, the nurses had to report the frequencies of each factor for missed nursing care (always happened, frequently happened, occasionally happened, rarely happened, never happened). Both the frequencies of the missed nursing care and the reason for missed nursing care were answered depending on the participants memory. The other covariables included nurse age and educational degree (3-year associate's degree, 4-year associate's degree, bachelor's degree, or higher). Out of all 48 nurses working in the NICU, 100% participated in this survey.

### Data analysis

Descriptive analysis was conducted using [Microsoft® Excel](#) v16.0 software and subsequently presented in a table which consists of participant characteristics, the distribution of the workload, the frequency of the missed nursing care, and the contributing factor frequency of the missed nursing care. The subscale of the workload would be presented in a graphic figure. The data analysis for this study was done with the [IBM SPSS Statistics](#) v 25.0 (RRID: SCR\_016479). Descriptive statistics were used to describe the sample characteristics, the frequency of missed nursing care items, and the frequency of the reason for missed nursing care. Test of normality for the total workload data was done using the Shapiro-Wilk test. The analysis utilized Pearson's correlations to measure the association between the total workload with the total of any missed care and Spearman rank correlations were calculated to assess the association between the total workload with each of the 11 missed care items;  $\alpha$  was corrected to 0.05.

## Results

### Descriptive findings

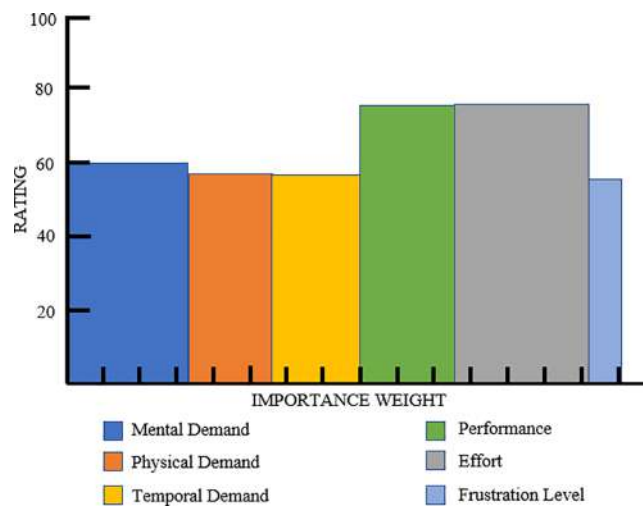
Out of the 48 nurses who participated in this study, all were female (100%).<sup>25</sup> The oldest participant was 56 years old. All participants submitted the surveys after getting enough information regarding the questions with 0% missing data. The majority of the nurse participants graduated with an associate's degree (72.9%), and only a small percentage had a master's degree (2.1%) ([Table 1](#)).

From the first part of the questionnaire, the NASA-TLX score could be calculated. The mean overall workload score based on NASA-TLX was 68, with 96 as the highest score (range, 42 to 96; median 67.33) out of 100 ([Table 1](#)). A higher NASA-TLX score indicated a higher overall workload experienced by the participants. The distribution of the six subscales can be seen in [Figure 1](#). The width of the subscale bars showed the importance of each factor, which were reflected as its weight and the height represents the magnitude/rating of each factor. Out of all the subscales, effort had the highest importance with the mean value of 3.625 and the highest magnitude/rating (mean value of 75.83). Meanwhile, frustration level has the lowest importance (mean value of 0.89) and lowest magnitude/rating (mean value 55.42).

**Table 1. Nurse participants and workload characteristics.**

Characteristic	N(%)	mean $\pm$ SD (Min-Max)
Age		40.33 $\pm$ 7.68 (26-56)
Education	3-year Associate's degree	35 (72.9)
	4-year Associate's degree	1 (2.1)
	Bachelor's degree	11 (22.9)
	Master's degree	1 (2.1)
NASA-TLX Overall workload score		68.36 $\pm$ 11.83 (42-96) <sup>a</sup>

Abbreviations: NASA-TLX, National Aeronautics and Space Administration Task Load Index.  
<sup>a</sup>Scores range from 0 (low) to 100 (high).



**Figure 1. The distribution of the weighted workload score.** The rating represents the magnitude of a load factor in a given task. Then, overall workload score for each subject can be obtained by multiplying each rating by the weight given to that factor by that subject. The sum of the weighted ratings for each task is then divided by 15 (the sum of the weights).

From the survey, 44 out of 48 (91.67%) participating nurses reported to omit at least one of the nursing care items. The percentage of missed care items by each nurse ranged from 4.76% to 61.9%, with a mean value of 27.92% and median value of 23.81%. The distribution of the missed nursing care can be seen in Table 2. From the report, most of the missed care items were either rarely missed or occasionally missed. From all the nursing care items, nurses most often missed giving emotional support to parents and/or family (33 [68.75%]) and performing bedside glucose monitoring as ordered (33 [68.75%]). Patients' assessments performed each shift was the least frequent nursing care to be missed (1 [2.1%]), beside mouth care (2 [4.2%]) and handwashing (2 [4.2%]).

The reason for missed nursing care was divided into three parts, consisting of communication factors, material resources factors, and labor resources factors (Table 3). Overall, from the communication factors, the problems either rarely or occasionally happened. The most frequent problem from the communications was tension or communication breakdown with other ancillary/support departments (30 [62.5%]). The least frequent problem was inadequate handoff from the previous shift or sending unit (5 [10.42%]). From the material resources factors, the majority of the problems also happened rarely or occasionally. Supplies/equipment not functioning properly when needed were the most frequent problems from the material resources factor (35 [72.72%]). Meanwhile in the labor resources factor, overall, the problems happened occasionally or frequently. Out of all the problems, urgent patient situations were the most frequent problem (47[97.92%]), followed by unexpected rise in patient volume and/or acuity on the unit (46 [95.83%]). Overall, the problems under labor resources factors had the highest frequency out of all the other factors for the missed nursing care to happen.

**Table 2. Distribution of missed nursing care.**

Missed nursing care	Response N (%)					Missed
	Rarely missed	Occasionally missed	Frequently missed	Always missed	Missed	
Ambulation three times per day or as ordered	11 (22.9)	9 (18.8)	7 (14.6)	0 (0)	27 (56.25)	
Turning patient every 2 hours	12 (25)	1 (2.1)	0 (0)	0 (0)	13 (27.1)	
Feeding patient when the food is still warm	4 (8.3)	2 (4.2)	0 (0)	0 (0)	6 (12.5)	
Setting up meals for patients	3 (6.3)	4 (8.3)	2 (4.2)	3 (6.3)	12 (25)	
Medications administered within 30 minutes before or after scheduled time	7 (14.6)	10 (20.8)	3 (8.3)	0 (0)	20 (41.67)	
Vital signs assessed as ordered	3 (6.3)	0 (0)	0 (0)	0 (0)	3 (6.3)	
Monitoring intake/output	1 (2.1)	1 (2.1)	0 (0)	0 (0)	2 (4.2)	
Full documentation of all necessary data	3 (6.3)	0 (0)	0 (0)	0 (0)	3 (6.3)	
Parents/Family teaching about procedures, tests, and other diagnostic studies	8 (16.7)	14 (29.2)	5 (10.4)	3 (6.3)	30 (62.5)	
Emotional support to parents and/or family	15 (31.3)	13 (27.1)	5 (10.4)	0 (0)	33 (68.75)	
Patient bathing/skin care	2 (4.2)	0 (0)	1 (2.1)	0 (0)	3 (6.25)	
Mouth care	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (4.2)	
Handwashing	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (4.2)	
Teaching parents/family about plans for their baby care after discharge and when to call after discharge	6 (12.5)	3 (6.3)	3 (6.3)	0 (0)	12 (25)	
Bedside glucose monitoring as ordered	7 (14.5)	18 (37.5)	7 (14.6)	1 (2.1)	33 (68.75)	
Patient assessments performed each shift	1 (2.1)	0 (0)	0 (0)	0 (0)	1 (2.1)	
IV/central line site care and assessments according to hospital policy	5 (10.4)	0 (0)	0 (0)	0 (0)	5 (10.4)	
Response to call light is initiated within 5 minutes	7 (14.6)	1 (2.1)	0 (0)	1 (2.1)	9 (18.75)	
PRN medication request acted on within 15 minutes	9 (18.8)	5 (10.4)	0 (0)	0 (0)	14 (29.17)	
Assess effectiveness of medications	7 (14.6)	2 (4.2)	2 (4.2)	1 (2.1)	12 (25)	
Assist with toileting needs within 5 minutes of request	9 (18.8)	5 (10.4)	2 (4.2)	0 (0)	16 (33.33)	

Abbreviations: IV, intravenous; PRN, pro re nata.

**Table 3. Frequency of reason for missed nursing care.**

Reason for missed nursing care	Response N (%)						Frequency <sup>a</sup>
	Never happened	Rarely happened	Occasionally happened	Frequently happened	Always happened		
<b>A. Communication - Overall</b>							
(The method of making patient assignments)Unbalanced patient assignments	40 (83.3)	5 (10.4)	3 (6.3)	0 (0)	0 (0)	8 (16.67)	
Inadequate handoff from previous shift or sending unit	43 (89.6)	4 (8.3)	0 (0)	0 (0)	1 (2.1)	5 (10.42)	
Other departments did not provide the care needed (e.g. physical therapy did not ambulate)	26 (54.2)	3 (6.3)	13 (27.1)	3 (6.3)	3 (6.3)	22 (45.83)	
Lack of backup support from team members	29 (60.4)	7 (14.6)	10 (20.8)	0 (0)	2 (4.2)	19 (39.58)	
Tension or communication breakdowns with other ancillary/support departments	18 (37.5)	12 (25)	12 (25)	4 (8.3)	2 (4.2)	30 (62.5)	
Tension or communication breakdowns within the nursing team	27 (56.3)	10 (20.8)	8 (16.7)	0 (0)	3 (6.3)	21 (43.75)	
Tension or communication breakdowns with the medical staff	26 (54.2)	12 (25)	7 (14.6)	0 (0)	3 (6.3)	22 (45.83)	
Nursing assistant did not communicate that care was not done	31 (64.6)	8 (16.7)	7 (14.6)	0 (0)	2 (4.2)	17 (35.42)	
Caregiver off unit or unavailable	27 (56.3)	1 (2.1)	15 (31.3)	2 (4.2)	3 (6.3)	21 (43.75)	
<b>B. Material Resources - Overall</b>							
Medications not available when needed	19 (39.6)	10 (20.8)	15 (31.3)	0 (0)	4 (8.3)	29 (60.42)	
Supplies/equipment not available when needed	17 (35.4)	12 (25)	16 (33.3)	0 (0)	3 (6.3)	31 (64.58)	
Supplies/equipment not functioning properly when needed	13 (27.1)	7 (14.6)	24 (50)	2 (4.2)	2 (4.2)	35 (72.92)	
<b>C. Labor Resources - Overall</b>							
(Level of staffing) Inadequate number of staff	7 (14.6)	10 (20.8)	18 (37.5)	9 (18.8)	4 (8.3)	41 (85.42)	
Urgent patient situations (e.g., a patient's condition worsening)	1 (2.1)	7 (14.6)	20 (41.7)	16 (33.3)	4 (8.3)	47 (97.92)	
Unexpected rise in patient volume and/or acuity on the unit	2 (4.2)	4 (8.3)	22 (45.8)	13 (27.1)	7 (14.6)	46 (95.83)	
Inadequate number of assistive personnel (e.g., nursing assistants, techs, unit secretaries, etc.)	17 (35.4)	3 (6.3)	16 (33.3)	7 (14.6)	5 (10.4)	31 (64.58)	

<sup>a</sup>Frequency = Rarely + Occasionally + Frequently + Always Happened.



**Table 4. Correlation of total workload with missed nursing care outcomes.**

Outcome	Workload Measures NASA-TLX total Workload, Correlation coefficient (P value)
Any missed care	0.092 (0.536)
Ambulation three times per day or as ordered	0.329 (0.022)*
Turning patient every 2 hours	0.212 (0.149)
Feeding patient when the food is still warm	0.159 (0.280)
Setting up meals for patients	0.245 (0.093)
Medications administered within 30 minutes before or after scheduled time	0.156 (0.291)
Vital signs assessed as ordered	-0.096 (0.515)
Monitoring intake/output	-0.184 (0.209)
Full documentation of all necessary data	0.071 (0.629)
Parents/Family teaching about procedures, tests, and other diagnostic studies	-0.093 (0.528)
Emotional support to parents and/or family	-0.019 (0.895)
Patient bathing/skin care	0.093 (0.528)
Mouth care	-0.087 (0.558)
Handwashing	0.132 (0.372)
Teaching parents/family about plans for their baby care after discharge and when to call after discharge	-0.226 (0.123)
Bedside glucose monitoring as ordered	-0.123 (0.404)
Patient assessments performed each shift	0.184 (0.210)
IV/central line site care and assessments according to hospital policy	-0.167 (0.255)
Response to call light is initiated within 5 minutes	-0.019 (0.897)
PRN medication request acted on within 15 minutes	-0.015 (0.920)
Assess effectiveness of medications	0.047 (0.752)
Assist with toileting needs within 5 minutes of request	-0.128 (0.387)

Abbreviations: IV, intravenous; NASA-TLX, National Aeronautics and Space Administration Task Load Index; PRN, pro re nata.

\*p<0.05,  $\alpha$  corrected for false discovery rate.

### Workload and missed care

The correlation of total workload with missed nursing care outcome can be seen in Table 4. The correlation of total workload measured with NASA-TLX with any missed care was analyzed with Pearson correlation, meanwhile the correlation of total workload with each of the missed nursing care items was analyzed with Spearman correlation. Out of all the missed nursing care items, only missed in ambulation care showed significant worsening effects with higher workload (correlation coefficient 0.329 p = 0.022). The other 21 models showed no statistically significant correlation with the total workload.

### Discussion

Contrary to our hypothesis, we found no statistically significant correlation between the total workload with the frequency of missed nursing care. However, current evidence indicates otherwise. A similar study conducted by Tubbs-Cooley, *et al.* (2019) found that NASA-TLX, as a subjective workload rating, had a statistically significant correlation with all the missed nursing care items assessed in their study.<sup>4</sup> Lake *et al.* (2018) also showed that nurses with higher workloads, higher acuity assignments, and poorly organized work environments were significantly associated with an increase in missed nursing care.<sup>26</sup> This might happen due to the reporting bias presented in the data collection process, in which the participants failed to accurately recall the nursing care items they missed. Age, education, and nurse work experience factors could also affect the result.

Considering the high number of neonatal mortality rates in developing countries, our study holds a great value to determine the source of one of the problems in neonatal care. We also found that there is still a limited amount of studies

on the workload and missed nursing care in the NICU, especially in developing countries. From our study, we found that the mean of the total workload score calculated with the NASA-TLX score is considered to be high. The subscale that showed the highest importance is the effort factor. Similar results are also present in a previous study regarding nurse workload in the Intensive Care Unit done in a hospital in Aceh, Indonesia.<sup>27</sup> Higher effort means higher requirement to work harder in order to achieve the necessary level of performance.<sup>23</sup> This finding could be related with the high demand in the NICU to monitor and provide appropriate treatment for intensive care neonates.<sup>28</sup> Meanwhile, frustration level showed the lowest importance subscale in our analysis. Frustration level regarded as the least contributing factor to the NICU nurse's workload could be correlated with the other high workload demand dimension not giving them enough space to think about the working condition. A multivariate regression conducted by Wang *et al.* (2016) showed that the age of senior nurses was positively correlated with work-related frustration.<sup>29</sup> This finding is contradictory with previous evidence which showed that nurses with longer experience exhibit a lower frustration level in regard with their adaptation level with the workplace pressure and task.<sup>27,30</sup> Overload of patient information due to the usage of electronic health records (EHR) was also shown to potentiate a higher level of frustration among nurses.<sup>31,32</sup>

Out of all the nurse care items done in the NICU, we found that the most frequently missed nursing care was giving emotional support to the patient's parents and/or family and bedside glucose monitoring as ordered. While the least frequent cares to be missed in this study were patient assessment each shift, mouth care, and handwashing. Consistent with several previous studies, giving emotional support is still one of the most frequent care items to be missed, although in this study we found an even greater proportion compared to the previous studies.<sup>5,33</sup> The high work demand in the NICU left the nurses with little time to do their tasks, this sometimes lead them to postpone some tasks deemed to be less "important", such as the psycho-social task including giving emotional support to the parents and/or family of the neonates.<sup>34,35</sup> Regarding bedside glucose monitoring, other studies presented opposite results, in which bedside glucose monitoring is part of the least frequent care to be missed.<sup>5,36</sup> Neonatal hypoglycemia is the most common metabolic disturbance in neonates, hence why hypoglycemia screening is a crucial consideration, especially in high-risk infants.<sup>37</sup> An extreme level of low blood glucose can cause several life-threatening conditions in neonates, such as apnea, irritability, lethargy, seizures, and even brain damage.<sup>38</sup> Failure to do bedside glucose monitoring as ordered can result in a dangerous situation to the neonates and hence, it is really important to increase the awareness of the consequences of omission<sup>39</sup> and to provide better bedside glucose monitoring devices<sup>40,41</sup> to reduce the morbidity caused by missed nursing care. Conversely, the top three least frequent missed nursing care could be related to the fact that they are too obvious to be missed and are routinely audited by the nursing units.<sup>36</sup> In regard to the increasing hospital quality, several protocols, such as hand hygiene, can also affect the nurse to prioritize some care over the others based on incentives or disincentives.<sup>5</sup>

For the other contributing factors to missed nursing care, labor resources factor is the most frequent problem, followed by the material resources factor and communication factor. The most frequent reasons are urgent patient situations and unexpected rise in patient volume and/or acuity. This finding is consistent with several previous studies.<sup>5,33,35,36</sup> Although labor resources hold the biggest portion in contributing to missed nursing care, interventions that exclusively focus on labor resources may not be enough to decrease the incidence of missed nursing care.<sup>4</sup> Intervention to ensure better teamwork, communication, as well as less excessive workload, better personnel deployment, and better flows in patient acuity and volume is needed to minimize the incidence of missed nursing care.<sup>36</sup> Improving the teamwork of the NICU team can ensure better safety for the patient, including better infection control, as well as reducing the error in giving intensive treatment to the neonates, such as neonatal resuscitation.<sup>42,43</sup> Regarding material resource factor, the most frequent challenge is when the provided supplies/equipment are not functioning properly when needed. A study by Perry and Malkin (2011) found that there were around 38.3% out of service medical equipment in developing countries.<sup>44</sup> The main reasons behind this equipment error were lack of training, poor health technology management, and poor infrastructure. Proper interventions are needed to solve this problem to increase the NICU nurse work-effectiveness.<sup>45</sup>

### Strengths and limitation

This study has several limitations. First, there is a limited size of samples in our analysis, hence it may not hold a sufficient power to detect any significant correlation between the various outcomes and workload measures. Second, the data collecting process requires nurses to assess missed nursing care based on the memory of their own experience which is highly susceptible to bias. In addition, the data was collected only once, conversely to the previous study that collected the data from each shift. There is also a possibility that the response to the questions is influenced by social aspect bias, thus the answer to the missed care might be under-represented rather than the actual situation. However, it is worthy to mention that this study had a high response rate, in which 100% of the nurses working in the NICU of the study hospital site participated in this study and filled out the survey after getting a proper explanation. This study was conducted in one of the biggest tertiary hospitals in Indonesia, therefore the findings of this study might be generalizable in similar settings. Further replication of this study in another setting within a developing country with larger samples and more collected data is required to support the role of nurse workload in missed nursing care.

## Conclusion

In our analysis, there was a high overall workload of NICU nurses. The effort factor was found to have the highest importance compared to the other subscales of nurse workload index. The most frequent forms of missed nursing care were giving emotional support to parents and/or family and bedside glucose monitoring. Although we found no statistically significant correlation between total workload and any missed nursing care, total workload exhibited significant correlation with missed ambulation (three times per day or as ordered). Labor resources factor was the other most important factor in regard to missed nursing care, especially in an urgent patient situation and unexpected increase in patient volume and/or acuity. However, labor-focused intervention might not be enough to resolve the problem. Intervention to ensure better teamwork, communication, and also better technology and medical equipment maintenance for a better workplace environment is necessary to increase the work productivity of NICU nurses.

## Data availability

### Underlying data

Figshare: Nurse Workload, Missed Nursing Care, and the Contributing Factors in the Neonatal Intensive Care Unit in a Limited Resource Setting: A Case from Indonesia. <https://doi.org/10.6084/m9.figshare.18096383>.<sup>25</sup>

This project contains the following underlying data:

- Raw Data\_NASA-TLX and MISSCARE Survey.xlsx (This file contains data regarding nurses' responses on the NASA-Task Load Index for assessing workload and the MISSCARE Survey for assessing frequency and factors contributing to missed nursing care)

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0)

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# Nurse workload, missed nursing care, and the contributing factors in the Neonatal Intensive Care Unit in a limited resource setting A case from Indonesia

*by Martono Tri Utomo*

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## RESEARCH ARTICLE

# Nurse workload, missed nursing care, and the contributing factors in the Neonatal Intensive Care Unit in a limited resource setting: A case from Indonesia [version 1; peer review: awaiting peer review]

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## Open Peer Review

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Any reports and responses or comments on the article can be found at the end of the article.

## Abstract

**Background:** Nurses who are in charge of the Neonatal Intensive Care Units (NICUs) have a different workload and work assignments compared to other units. Evidence suggests that higher nurse workloads will increase the risk of missed nursing care. Missed nursing care in the NICU will eventually worsen the neonatal prognosis. This is a major problem in developing countries, which currently still have a high neonatal mortality rate.

**Methods:** This was a cross sectional study using questionnaires to collect data from 48 nurses who work in Dr. Soetomo Hospital NICU from April 15<sup>th</sup> 2021 to July 25<sup>th</sup> 2021. The collected data was then processed with descriptive statistics, meanwhile the correlation between workload with missed nursing care was analyzed with Pearson and Spearman correlation.

**Results:** The total mean of NICU nurse workload score according to the NASA-TLX (National Aeronautics and Space Administration Task Load Index) was 68.36, indicating a moderate overall workload, with effort as the highest component. Overall, 91.67% of the nurses had missed at least 1 out of 21 basic neonatal nursing care components. Labor resource factor was the most frequent missed nursing care

factor, in which urgent patient situations were the most frequent problem. There was no significant correlation between the total nurse workload and the frequency of any missed nursing care ( $P=0.536$ ).

**Conclusions:** Effort was the biggest component of the NICU nurse total workload. The most frequently missed nursing care was giving emotional support for the patient's parents and/or family. Labor resource factor was the most frequent problem which caused missed nursing care. However, there is no statistically significant correlation between the total workload with the frequency of missed nursing care.

#### Keywords

nurse workload, missed nursing care, nurse, neonate, NICU nurse

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## Introduction

Neonatal period, which is the first 28 days of life, is an extremely important period for children's survival. With the majority of neonatal deaths happening in the first week of life, newborns are facing many high risks of dying in this vulnerable period (<https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality>). Globally, there were around 2.4 million neonatal deaths in 2019, in which a high portion of it comes from low and lower middle-income countries, including Indonesia (around 60 thousand neonatal deaths in 2019) (<https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality>). Several contributing factors are preterm birth, infections and birth defects (<https://data.unicef.org/topic/child-survival/neonatal-mortality>).

<sup>49</sup> The Neonatal Intensive Care Unit (NICU) is a specialized area in the hospital that provides advanced technologies and trained healthcare professionals for the treatment of high-risk newborns from prematurity, low birth weight, and specific health condition (respiratory problem, heart problem, infection, or birth defects) (<https://www.stanfordchildrens.org/en/topic/default?id=the-neonatal-intensive-care-unit-nicu-90-P02389>). According to a study conducted from 2009 until 2010 in Nepal, as a developing country, among the aforementioned conditions, respiratory distress was shown as the most common neonatal condition which led to NICU admission.<sup>1</sup> Despite being expensive and not easily accessible, the NICU is an extremely important unit that can not only save lives but can also help in increasing the survival rates for neonates.

The NICU as a setting with higher nurse-to-patient ratio has a different nurse workload and assignment compared to other units. Although most NICU infants are low-acuity, around 12% of the high acuity infants will need higher staffing ratio (around 0.95) compared to lower acuity infants (around 0.33). This nurse shortage, which will increase the nurse workload, can lead to care being delayed or omitted which will increase infant mortality.<sup>2,3</sup> A study conducted in a Midwestern academic medical center showed that the workload of NICU nurses based on the subjective workload rating of National Aeronautics and Space Administration Task Load Index (NASA-TLX), was significantly associated with missed nursing care.<sup>4</sup> Missed care is theorized to be linked with poor work environments and staffing.<sup>4-6</sup>

<sup>10</sup> Higher quality care for infants and their parents in the NICU will provide them with better outcomes. Life threatening conditions, such as neonatal infections, can be prevented with a high quality of care, including appropriate hand hygiene and central-line care practice.<sup>7-10</sup> Preparation of families for discharge given by the nurse is crucial to ensure that parents could manage their infant's care after being discharged from the NICU. High quality care for infants and their parents in the NICU will provide them with better outcomes.<sup>11</sup> In contrast, misses in nurse care will cause poor outcomes for infants hospitalized in the NICU which were already at high risk.<sup>6,12</sup> Although neonatal care has improved considerably in developing countries, there are still several unresolved challenges remaining when compared to developed countries.<sup>13</sup> Poor infrastructure, resource limitation, and a lack of referral systems are several problems faced by the developing countries in providing optimal neonatal care.<sup>13,14</sup> The prognosis for infants admitted to the NICU in developing countries remains poor, with limited evidence indicating a mortality rate between 0.2 to 64.4%.<sup>15</sup> This high mortality rate is related to a higher prevalence of newborn infections in developing countries compared with developed countries.<sup>16-18</sup> A systematic literature review by Kermani *et al.* (2020) identified 90 risk factors associated with neonatal mortality in the NICU, which are categorized into 25 maternal factors, 59 neonatal factors, and 6 organizational factors.<sup>19</sup> Several factors associated with neonatal mortality include scarcity of trained health care personnel, overcrowding of the neonatal units, late onset and slow advance of feeding, use of formula instead of breastfeeding, failure to comply with handwashing recommendations, and excessive use of antibiotics.<sup>18,20,21</sup> With the majority of the neonatal deaths coming from the developing country, there is an urgency to implement the appropriate interventions to reduce the number of missed nursing care in the NICU. Therefore, there is a need to inform the implementation of such interventions, especially regarding the current existing missed NICU nursing care and factors associated with it in a limited resource setting.

<sup>42</sup> This study aims to evaluate the NICU nurse workload, the frequency of missed NICU nursing care, and the other contributing factors associated with missed NICU nursing care in developing countries by analyzing data obtained from 48 nurses working in Dr. Soetomo General Hospital, a central referral hospital in East Java, Indonesia. We hypothesized that nurses with higher subjective workload (NASA-TLX) would significantly miss more care.

## Methods

### Ethical considerations

Ethical clearance was granted from IRB Dr. Soetomo General Hospital by letter of exemption 0335/LOE/301.4.2/II/2021. Written informed consent was obtained from participating nurses.

### <sup>40</sup> Study design, data, and sample

This was a cross-sectional study using questionnaires to collect data from the nurses working in the Neonatal Intensive Care Unit (NICU) of Dr. Soetomo General Hospital, a central referral hospital in East Java, Indonesia. Registered NICU

nurses were defined if they had completed unit orientation, had provided direct patient care, and were actively employed in the NICU. All of the defined NICU nurses were found to be eligible to participate in our study. Hence, a total sampling frame was determined to establish the final study size of 48 nurses. Participants were recruited via direct solicitations in the department of pediatrics of Dr. Soetomo General Hospital. The study participants, split into three groups, were gathered in a room to be given the information regarding the study and the instruction on how to fill in the NASA-TLX questionnaires. Then the questionnaires were given to participants by a trained research assistant after enough information had been given.

The questionnaires were split into three sections, which were: a) nurse workload, b) frequency of miss in nurse care, and c) factor contributing to miss care. Nurse workload was assessed using the paper version of the NASA-TLX.<sup>22,23</sup> The questions were translated to Indonesian language and went through several processes of validity testing, including the testing to clarify whether there were any mistranslation or loss of meaning during the translation, testing for the questions clarity, and testing for any bias regarding the translated questions. There were six components measured by the NASA-TLX, which consists of mental demands, physical demands, time pressure, effort to accomplish goals, performance, and frustration. Total workload scores were then calculated by the sum of the adjusted rating (weight  $\times$  raw rating) divided by 15. The scores for overall workload scores ranged from 0 (low) to 100 (high). The second and third part of the questionnaire were taken from the MISSCARE Survey-English.<sup>24</sup> Its content validity index was 0.87 with test-retest validity ( $r=0.88$ ,  $p<0.001$ ). The survey consists of 21 items of essential neonatal nursing care and the reason for missed nursing care divided into three categories (communication, material resources, and labor resources). The MISSCARE Survey was translated into Indonesian language through several processes to ensure no compromise in any loss of meaning during the translation. The translated survey was subsequently disseminated to an expert panel in order to evaluate the internal validity. The survey was also disseminated to 10 nurses for external face validity to evaluate their interpretation and understanding of each item. Missed nursing care was assessed by asking nurses to report the omission frequency of the 21 neonatal nursing care practices. The frequency was divided based on a Likert type scale, which are: always missed, frequently missed, occasionally missed, rarely missed, and never missed. The responses were then dichotomized into missed or not missed for each of the 21 items. In the third part, the nurses were asked to assess and chose the reasons for missed nursing care in their unit among the presented options in the questionnaire. For each question, the nurses had to report the frequencies of each factor for missed nursing care (always happened, frequently happened, occasionally happened, rarely happened, never happened). Both the frequencies of the missed nursing care and the reason for missed nursing care were answered depending on the participants memory. The other covariables included nurse age and educational degree (3-year associate's degree, 4-year associate's degree, bachelor's degree, or higher). Out of all 48 nurses working in the NICU, 100% participated in this survey.

#### Data analysis

Descriptive analysis was conducted using Microsoft<sup>®</sup> Excel v16.0 software and subsequently presented in a table which consists of participant characteristics, the distribution of the workload, the frequency of the missed nursing care, and the contributing factor frequency of the missed nursing care. The subscale of the workload would be presented in a graphic figure. The data analysis for this study was done with the IBM SPSS Statistics v 25.0 (RRID: SCR\_016479). Descriptive statistics were used to describe the sample characteristics, the frequency of missed nursing care items, and the frequency of the reason for missed nursing care. Test of normality for the total workload data was done using the Shapiro-Wilk test. The analysis utilized Pearson's correlations to measure the association between the total workload with the total of any missed care and Spearman rank correlations were calculated to assess the association between the total workload with each of the 11 missed care items;  $\alpha$  was corrected to 0.05.

## Results

### Descriptive findings

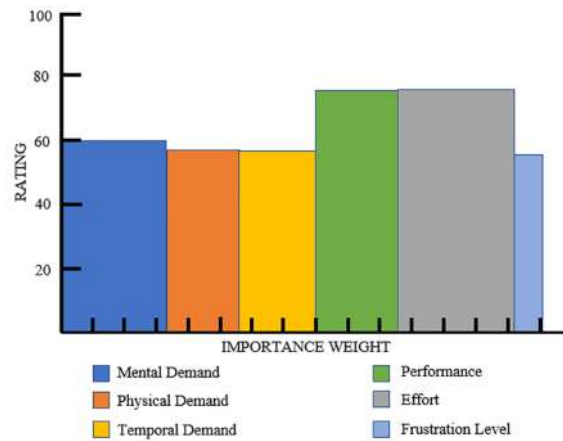
Out of the 48 nurses who participated in this study, all were female (100%).<sup>25</sup> The oldest participant was 56 years old. All participants submitted the surveys after getting enough information regarding the questions with 0% missing data. The majority of the nurse participants graduated with an associate's degree (72.9%), and only a small percentage had a master's degree (2.1%) (Table 1).

From the first part of the questionnaire, the NASA-TLX score could be calculated. The mean overall workload score based on NASA-TLX was 68, with 96 as the highest score (range, 42 to 96; median 67.33) out of 100 (Table 1). A higher NASA-TLX score indicated a higher overall workload experienced by the participants. The distribution of the six subscales can be seen in Figure 1. The width of the subscale bars showed the importance of each factor, which were reflected as its weight and the height represents the magnitude/rating of each factor. Out of all the subscales, effort had the highest importance with the mean value of 3.625 and the highest magnitude/rating (mean value of 75.83). Meanwhile, frustration level has the lowest importance (mean value of 0.89) and lowest magnitude/rating (mean value 55.42).

**Table 1. Nurse participants and workload characteristics.**

Characteristic	N(%)	mean ± SD (Min-Max)
Age		40.33 ± 7.68 (26-56)
Education	3-year Associate's degree	35 (72.9)
	4-year Associate's degree	1 (2.1)
	Bachelor's degree	11 (22.9)
	Master's degree	1 (2.1)
NASA-TLX Overall workload score		68.36 ± 11.83 (42-96) <sup>a</sup>

Abbreviations: NASA-TLX, National Aeronautics and Space Administration Task Load Index.  
<sup>a</sup>Scores range from 0 (low) to 100 (high).



**Figure 1. The distribution of the weighted workload score.** The rating represents the magnitude of a load factor in a given task. Then, overall workload score for each subject can be obtained by multiplying each rating by the weight given to that factor by that subject. The sum of the weighted ratings for each task is then divided by 15 (the sum of the weights).

From the survey, 44 out of 48 (91.67%) participating nurses reported to omit at least one of the nursing care items. The percentage of missed care items by each nurse ranged from 4.76% to 61.9%, with a mean value of 27.92% and median value of 23.81%. The distribution of the missed nursing care can be seen in Table 2. From the report, most of the missed care items were either rarely missed or occasionally missed. From all the nursing care items, nurses most often missed giving emotional support to parents and/or family (33 [68.75%]) and performing bedside glucose monitoring as ordered (33 [68.75%]). Patients' assessments performed each shift was the least frequent nursing care to be missed (1 [2.1%]), beside mouth care (2 [4.2%]) and handwashing (2 [4.2%]).

The reason for missed nursing care was divided into three parts, consisting of communication factors, material resources factors, and labor resources factors (Table 3). Overall, from the communication factors, the problems either rarely or occasionally happened. The most frequent problem from the communications was tension or communication breakdown with other ancillary/support departments (30 [62.5%]). The least frequent problem was inadequate handoff from the previous shift or sending unit (5 [10.42%]). From the material resources factors, the majority of the problems also happened rarely or occasionally. Supplies/equipment not functioning properly when needed were the most frequent problems from the material resources factor (35 [72.72%]). Meanwhile in the labor resources factor, overall, the problems happened occasionally or frequently. Out of all the problems, urgent patient situations were the most frequent problem (47[97.92%]), followed by unexpected rise in patient volume and/or acuity on the unit (46 [95.83%]). Overall, the problems under labor resources factors had the highest frequency out of all the other factors for the missed nursing care to happen.

**Table 2. Distribution of missed nursing care.**

Missed nursing care	Response N (%)					
	Rarely missed	Occasionally missed	Frequently missed	Always missed	Missed	
Ambulation three times per day or as ordered	11 (22.9)	9 (18.8)	7 (14.6)	0 (0)	27 (56.25)	
Turning patient every 2 hours	12 (25)	1 (2.1)	0 (0)	0 (0)	13 (27.1)	
Feeding patient when the food is still warm	4 (8.3)	2 (4.2)	0 (0)	0 (0)	6 (12.5)	
Setting up meals for patients	3 (6.3)	4 (8.3)	2 (4.2)	3 (6.3)	12 (25)	
Medications administered within 30 minutes before or after scheduled time	7 (14.6)	10 (20.8)	3 (8.3)	0 (0)	20 (41.67)	
Vital signs assessed as ordered	3 (6.3)	0 (0)	0 (0)	0 (0)	3 (6.3)	
Monitoring intake/output	1 (2.1)	1 (2.1)	0 (0)	0 (0)	2 (4.2)	
Full documentation of all necessary data	3 (6.3)	0 (0)	0 (0)	0 (0)	3 (6.3)	
Parents/Family teaching about procedures, tests, and other diagnostic studies	8 (16.7)	14 (29.2)	5 (10.4)	3 (6.3)	30 (62.5)	
Emotional support to parents and/or family	15 (31.3)	13 (27.1)	5 (10.4)	0 (0)	33 (68.75)	
Patient bathing/skin care	2 (4.2)	0 (0)	1 (2.1)	0 (0)	3 (6.25)	
Mouth care	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (4.2)	
Handwashing	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (4.2)	
Teaching parents/family about plans for their baby care after discharge and when to call after discharge	6 (12.5)	3 (6.3)	3 (6.3)	0 (0)	12 (25)	
Bedside glucose monitoring as ordered	7 (14.5)	18 (37.5)	7 (14.6)	1 (2.1)	33 (68.75)	
Patient assessments performed each shift	1 (2.1)	0 (0)	0 (0)	0 (0)	1 (2.1)	
IV/central line site care and assessments according to hospital policy	5 (10.4)	0 (0)	0 (0)	0 (0)	5 (10.4)	
Response to call light is initiated within 5 minutes	7 (14.6)	1 (2.1)	0 (0)	1 (2.1)	9 (18.75)	
PRN medication request acted on within 15 minutes	9 (18.8)	5 (10.4)	0 (0)	0 (0)	14 (29.17)	
Assess effectiveness of medications	7 (14.6)	2 (4.2)	2 (4.2)	1 (2.1)	12 (25)	
Assist with toileting needs within 5 minutes of request	9 (18.8)	5 (10.4)	2 (4.2)	0 (0)	16 (33.33)	

Abbreviations: IV, intravenous; PRN, pro re nata.

**Table 3. Frequency of reason for missed nursing care.**

Reason for missed nursing care	Response N (%)						Frequency <sup>a</sup>
	Never happened	Rarely happened	Occasionally happened	Frequently happened	Always happened		
<b>A. Communication - Overall</b>							
(The method of making patient assignments) Unbalanced patient assignments	40 (83.3)	5 (10.4)	3 (6.3)	0 (0)	0 (0)	8 (16.67)	
Inadequate handoff from previous shift or sending unit	43 (89.6)	4 (8.3)	0 (0)	0 (0)	1 (2.1)	5 (10.42)	
Other departments did not provide the care needed (e.g. physical therapy did not ambulate)	26 (54.2)	3 (6.3)	13 (27.1)	3 (6.3)	3 (6.3)	22 (45.83)	
Lack of backup support from team members	29 (60.4)	7 (14.6)	10 (20.8)	0 (0)	2 (4.2)	19 (39.58)	
Tension or communication breakdowns with other ancillary/support departments	18 (37.5)	12 (25)	12 (25)	4 (8.3)	2 (4.2)	30 (62.5)	
Tension or communication breakdowns within the nursing team	27 (56.3)	10 (20.8)	8 (16.7)	0 (0)	3 (6.3)	21 (43.75)	
Tension or communication breakdowns with the medical staff	26 (54.2)	12 (25)	7 (14.6)	0 (0)	3 (6.3)	22 (45.83)	
Nursing assistant did not communicate that care was not done	31 (64.6)	8 (16.7)	7 (14.6)	0 (0)	2 (4.2)	17 (35.42)	
Caregiver off unit or unavailable	27 (56.3)	1 (2.1)	15 (31.3)	2 (4.2)	3 (6.3)	21 (43.75)	
<b>B. Material Resources - Overall</b>							
Medications not available when needed	19 (39.6)	10 (20.8)	15 (31.3)	0 (0)	4 (8.3)	29 (60.42)	
Supplies/equipment not available when needed	17 (35.4)	12 (25)	16 (33.3)	0 (0)	3 (6.3)	31 (64.58)	
Supplies/equipment not functioning properly when needed	13 (27.1)	7 (14.6)	24 (50)	2 (4.2)	2 (4.2)	35 (72.92)	
<b>C. Labor Resources - Overall</b>							
(Level of staffing) Inadequate number of staff	7 (14.6)	10 (20.8)	18 (37.5)	9 (18.8)	4 (8.3)	41 (85.42)	
Urgent patient situations (e.g., a patient's condition worsening)	1 (2.1)	7 (14.6)	20 (41.7)	16 (33.3)	4 (8.3)	47 (97.92)	
Unexpected rise in patient volume and/or acuity on the unit	2 (4.2)	4 (8.3)	22 (45.8)	13 (27.1)	7 (14.6)	46 (95.83)	
Inadequate number of assistive personnel (e.g., nursing assistants, techs, unit secretaries, etc.)	17 (35.4)	3 (6.3)	16 (33.3)	7 (14.6)	5 (10.4)	31 (64.58)	

<sup>a</sup>Frequency = Rarely + Occasionally + Frequently + Always Happened.

**Table 4. Correlation of total workload with missed nursing care outcomes.**

Outcome	Workload Measures NASA-TLX total Workload, Correlation coefficient (P value)
Any missed care	0.092 (0.536)
Ambulation three times per day or as ordered	0.329 (0.022)*
Turning patient every 2 hours	0.212 (0.149)
Feeding patient when the food is still warm	0.159 (0.280)
Setting up meals for patients	0.245 (0.093)
Medications administered within 30 minutes before or after scheduled time	0.156 (0.291)
Vital signs assessed as ordered	-0.096 (0.515)
Monitoring intake/output	-0.184 (0.209)
Full documentation of all necessary data	0.071 (0.629)
Parents/Family teaching about procedures, tests, and other diagnostic studies	-0.093 (0.528)
Emotional support to parents and/or family	-0.019 (0.895)
Patient bathing/skin care	0.093 (0.528)
Mouth care	-0.087 (0.558)
Handwashing	0.132 (0.372)
Teaching parents/family about plans for their baby care after discharge and when to call after discharge	-0.226 (0.123)
Bedside glucose monitoring as ordered	-0.123 (0.404)
Patient assessments performed each shift	0.184 (0.210)
IV/central line site care and assessments according to hospital policy	-0.167 (0.255)
Response to call light is initiated within 5 minutes	-0.019 (0.897)
PRN medication request acted on within 15 minutes	-0.015 (0.920)
Assess effectiveness of medications	0.047 (0.752)
Assist with toileting needs within 5 minutes of request	-0.128 (0.387)

Abbreviations: IV, intravenous; NASA-TLX, National Aeronautics and Space Administration Task Load Index; PRN, pro re nata.  
\*p<0.05,  $\alpha$  corrected for false discovery rate.

### Workload and missed care

The correlation of total workload with missed nursing care outcome can be seen in Table 4. The correlation of total workload measured with NASA-TLX with any missed care was analyzed with Pearson correlation, meanwhile the correlation of total workload with each of the missed nursing care items was analyzed with Spearman correlation. Out of all the missed nursing care items, only missed in ambulation care showed significant worsening effects with higher workload (correlation coefficient 0.329  $p = 0.022$ ). The other 21 models showed no statistically significant correlation with the total workload.

### Discussion

Contrary to our hypothesis, we found no statistically significant correlation between the total workload with the frequency of missed nursing care. However, current evidence indicates otherwise. A similar study conducted by Tubbs-Cooley, *et al.* (2019) found that NASA-TLX, as a subjective workload rating, had a statistically significant correlation with all the missed nursing care items assessed in their study.<sup>4</sup> Lake *et al.* (2018) also showed that nurses with higher workloads, higher acuity assignments, and poorly organized work environments were significantly associated with an increase in missed nursing care.<sup>26</sup> This might happen due to the reporting bias presented in the data collection process, in which the participants failed to accurately recall the nursing care items they missed. Age, education, and nurse work experience factors could also affect the result.

Considering the high number of neonatal mortality rates in developing countries, our study holds a great value to determine the source of one of the problems in neonatal care. We also found that there is still a limited amount of studies

14 on the workload and missed nursing care in the NICU, especially in developing countries. From our study, we found that the mean of the total workload score calculated with the NASA-TLX score is considered to be high. The subscale that showed the highest importance is the effort factor. Similar results are also present in a previous study regarding nurse workload in the Intensive Care Unit done in a hospital in Aceh, Indonesia.<sup>27</sup> Higher effort means higher requirement to work harder in order to achieve the necessary level of performance.<sup>23</sup> This finding could be related with the high demand in the NICU to monitor and provide appropriate treatment for intensive care neonates.<sup>28</sup> Meanwhile, frustration level showed the lowest importance subscale in our analysis. Frustration level regarded as the least contributing factor to the NICU nurse's workload could be correlated with the other high workload demand dimension not giving them enough space to think about the working condition. A multivariate regression conducted by Wang *et al.* (2016) showed that the age of senior nurses was positively correlated with work-related frustration.<sup>29</sup> This finding is contradictory with previous evidence which showed that nurses with longer experience exhibit a lower frustration level in regard with their adaptation level with the workplace pressure and task.<sup>27,30</sup> Overload of patient information due to the usage of electronic health records (EHR) was also shown to potentiate a higher level of frustration among nurses.<sup>31,32</sup>

Out of all the nurse care items done in the NICU, we found that the most frequently missed nursing care was giving emotional support to the patient's parents and/or family and bedside glucose monitoring as ordered. While the least frequent cares to be missed in this study were patient assessment each shift, mouth care, and handwashing. Consistent with several previous studies, giving emotional support is still one of the most frequent care items to be missed, although in this study we found an even greater proportion compared to the previous studies.<sup>5,33</sup> The high work demand in the NICU left the nurses with little time to do their tasks, this sometimes lead them to postpone some tasks deemed to be less "important", such as the psycho-social task including giving emotional support to the parents and/or family of the neonates.<sup>34,35</sup> Regarding bedside glucose monitoring, other studies presented opposite results, in which bedside glucose monitoring is part of the least frequent care to be missed.<sup>5,36</sup> Neonatal hypoglycemia is the most common metabolic disturbance in neonates, hence why hypoglycemia screening is a crucial consideration, especially in high-risk infants.<sup>37</sup> An extreme level of low blood glucose can cause several life-threatening conditions in neonates, such as apnea, irritability, lethargy, seizures, and even brain damage.<sup>38</sup> Failure to do bedside glucose monitoring as ordered can result in a dangerous situation to the neonates and hence, it is really important to increase the awareness of the consequences of omission<sup>39</sup> and to provide better bedside glucose monitoring devices<sup>40,41</sup> to reduce the morbidity caused by missed nursing care. Conversely, the top three least frequent missed nursing care could be related to the fact that they are too obvious to be missed and are routinely audited by the nursing units.<sup>36</sup> In regard to the increasing hospital quality, several protocols, such as hand hygiene, can also affect the nurse to prioritize some care over the others based on incentives or disincentives.<sup>5</sup>

71 For the other contributing factors to missed nursing care, labor resources factor is the most frequent problem, followed by the material resources factor and communication factor. The most frequent reasons are urgent patient situations and unexpected rise in patient volume and/or acuity. This finding is consistent with several previous studies.<sup>5,33,35,36</sup> Although labor resources hold the biggest portion in contributing to missed nursing care, interventions that exclusively focus on labor resources may not be enough to decrease the incidence of missed nursing care.<sup>4</sup> Intervention to ensure better teamwork, communication, as well as less excessive workload, better personnel deployment, and better flows in patient acuity and volume is needed to minimize the incidence of missed nursing care.<sup>36</sup> Improving the teamwork of the NICU team can ensure better safety for the patient, including better infection control, as well as reducing the error in giving intensive treatment to the neonates, such as neonatal resuscitation.<sup>42,43</sup> Regarding material resource factor, the most frequent challenge is when the provided supplies/equipment are not functioning properly when needed. A study by Perry and Malkin (2011) found that there were around 38.3% out of service medical equipment in developing countries.<sup>44</sup> The main reasons behind this equipment error were lack of training, poor health technology management, and poor infrastructure. Proper interventions are needed to solve this problem to increase the NICU nurse work-effectiveness.<sup>45</sup>

### Strengths and limitation

This study has several limitations. First, there is a limited size of samples in our analysis, hence it may not hold a sufficient power to detect any significant correlation between the various outcomes and workload measures. Second, the data collecting process requires nurses to assess missed nursing care based on the memory of their own experience which is highly susceptible to bias. In addition, the data was collected only once, conversely to the previous study that collected the data from each shift. There is also a possibility that the response to the questions is influenced by social aspect bias, thus the answer to the missed care might be under-represented rather than the actual situation. However, it is worthy to mention that this study had a high response rate, in which 100% of the nurses working in the NICU of the study hospital site participated in this study and filled out the survey after getting a proper explanation. This study was conducted in one of the biggest tertiary hospitals in Indonesia, therefore the findings of this study might be generalizable in similar settings. Further replication of this study in another setting within a developing country with larger samples and more collected data is required to support the role of nurse workload in missed nursing care.

## Conclusion

In our analysis, there was a high overall workload of NICU nurses. The effort factor was found to have the highest importance compared to the other subscales of nurse workload index. The most frequent forms of missed nursing care were giving emotional support to parents and/or family and bedside glucose monitoring. Although we found no statistically significant correlation between total workload and any missed nursing care, total workload exhibited significant correlation with missed ambulation (three times per day or as ordered). Labor resources factor was the other most important factor in regard to missed nursing care, especially in an urgent patient situation and unexpected increase in patient volume and/or acuity. However, labor-focused intervention might not be enough to resolve the problem. Intervention to ensure better teamwork, communication, and also better technology and medical equipment maintenance for a better workplace environment is necessary to increase the work productivity of NICU nurses.

## Data availability

### Underlying data

Figshare: Nurse Workload, Missed Nursing Care, and the Contributing Factors in the Neonatal Intensive Care Unit in a Limited Resource Setting: A Case from Indonesia. <https://doi.org/10.6084/m9.figshare.18096383>.<sup>25</sup>

This project contains the following underlying data:

- Raw Data\_NASA-TLX and MISSCARE Survey.xlsx (This file contains data regarding nurses' responses on the NASA-Task Load Index for assessing workload and the MISSCARE Survey for assessing frequency and factors contributing to missed nursing care)

Data are available under the terms of the [Creative Commons Attribution 4.0 International license \(CC-BY 4.0\)](https://creativecommons.org/licenses/by/4.0/)

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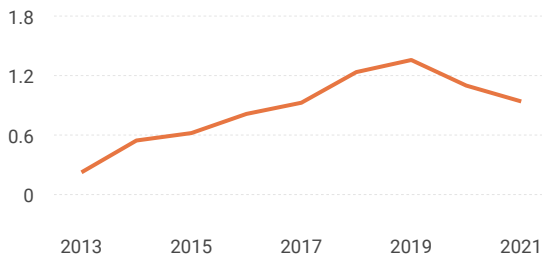
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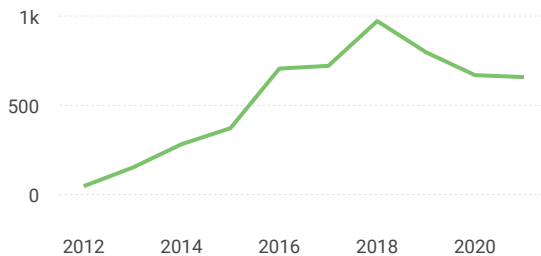
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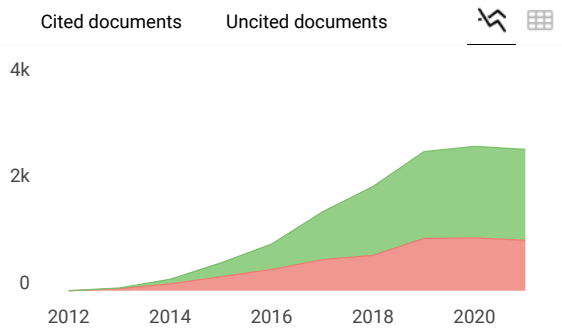
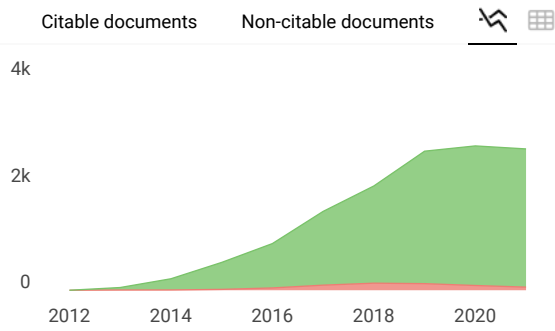
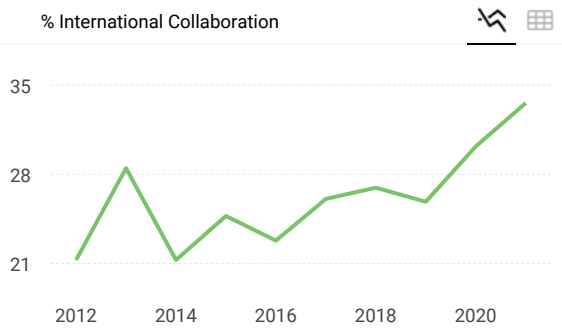
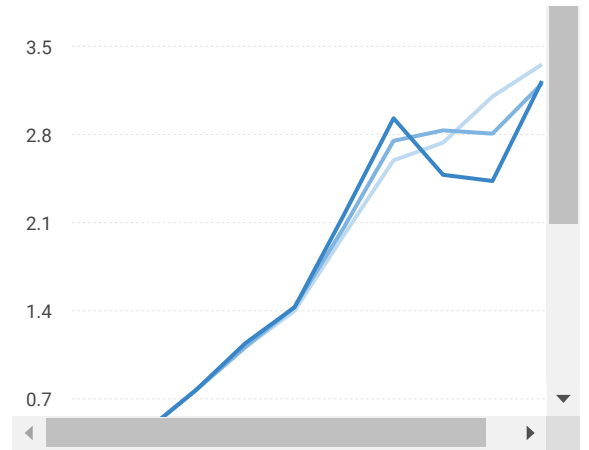
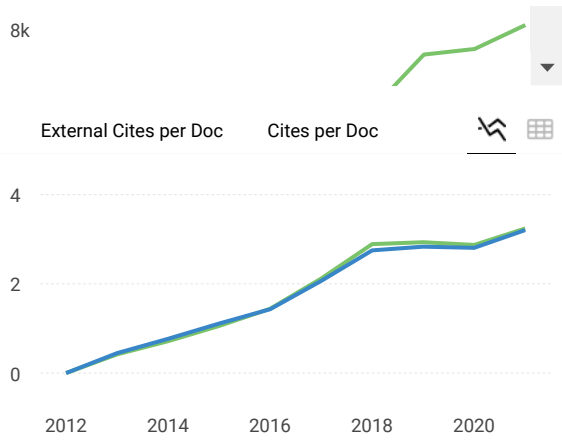
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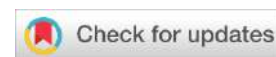


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## RESEARCH ARTICLE

# Neonatal resuscitation: A cross-sectional study measuring the readiness of healthcare personnel [version 1; peer review: awaiting peer review]

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## Abstract

**Background:** The optimal neonatal resuscitation requires healthcare personnel knowledge and experience. This study aims to assess the readiness of hospitals through its healthcare personnel in performing neonatal resuscitation.

**Methods:** This study was an observational study conducted in May 2021 by distributing questionnaires to nurses, midwives, doctors, and residents to determine the level of knowledge and experience of the subject regarding neonatal resuscitation. We conducted the research in four types of hospitals A, B, C, and D, which are defined by the Regulation of the Minister of Health of the Republic of Indonesia by the capability and availability of medical services. The type A hospital is the hospital with the most complete medical services, while type D hospitals have the least medical services. The comparative analysis between participants' characteristics and the knowledge or experience score was conducted.

**Results:** The total 123 participants are included in the knowledge questionnaire analysis and 70 participants are included in the resuscitation experience analysis. We showed a significant difference ( $p = 0.013$ ) of healthcare personnel knowledge between the A type hospital (Median 15.00; Interquartile Range [IQR] 15.00–16.00) and the C type hospital (median 14.50; IQR 12.25–15.75). For the experience, the healthcare personnel of type A and type B hospitals have significantly higher experience scores than the type D hospital ( $p =$

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0.014;  $p = 0.007$ ), but we did not find a significant difference between others type of hospital comparison.

**Conclusions:** In this study, we found that the healthcare personnel from type A and type B hospitals are more experienced than the type D hospital in conducting neonatal resuscitation. We suggest more neonatal resuscitation training to improve the readiness of healthcare personnel from type C and type D hospital.

### Keywords

Healthcare Personnel, Hospital, Neonate, Readiness, Resuscitation

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## Background

Neonatal mortality is one of the standards of neonatal care. Data from developing countries showed that about 4 million babies die in the neonatal period.<sup>1</sup> As a developing country, Indonesia also contributes, with the mortality rate reaching 12.4 per 1,000 live births in 2019.<sup>2</sup> The right strategy for neonatal referral and the readiness of the hospital must be assessed to decrease the neonatal mortality rate in Indonesia.<sup>3,4</sup>

The leading causes of neonatal mortality were prematurity, sepsis, and asphyxia.<sup>5–7</sup> These conditions are often related to the requirement of neonatal resuscitation.<sup>8,9</sup> Neonatal resuscitation is a series of procedures performed to prevent the morbidity and mortality associated with a hypoxic-ischemic tissue injury (brain, heart, kidney) and restore spontaneous breathing and adequate cardiac output.<sup>10,11</sup> The appropriate neonatal resuscitation is believed to increase the survival of neonates and reduce the mortality.<sup>12</sup>

The neonatal resuscitation service and patient prognosis were strong influence factors in the success of this procedure. Essential tools also must be available and ready to use whenever needed.<sup>11,13</sup> The healthcare personnel which play important roles on the neonatal resuscitation must be prepared by several trainings.<sup>14</sup> The trainings are expected to increase the healthcare personnel's capability and confidence in doing neonatal resuscitation.<sup>15</sup>

To provide optimal services, healthcare personnel must be prepared with both knowledge and experience.<sup>16–18</sup> Therefore, the factors that are associated with the knowledge and experience of the healthcare personnel need to be discovered. This study aims to assess the readiness of hospitals by analyzing the knowledge and experience of healthcare personnel in performing neonatal resuscitation.

## Methods

### Study design and participants

This research has obtained permission from the Ethics Committee of RSUD Dr. Soetomo Surabaya (Letter of Exemption 0335/LOE/301.4.2/II/2021). The data in this study was collected in May 2021 by distributing questionnaires to nurses, midwives, doctors, and residents to determine the level of knowledge and experience of the subject regarding neonatal resuscitation. The researchers met the participants and gave the explanation about the questionnaire in the pediatrics department of each hospital. Subjects in this study have filled out a statement of consent to be involved in this study. To address potential sources of bias, we invited respondents from all types of hospitals (A-D) to participate in our study.

### Data collection

This study was conducted in May 2021. The participants filled out the questionnaire for knowledge and experience measurement.<sup>19,20</sup> The questionnaire was adopted from Jukkala *et al.*<sup>20</sup> study with their permission. They developed questionnaires for measuring knowledge and experience in hospital settings. The questionnaires were then translated into Indonesian. The questionnaire was validated by several experts in neonatal resuscitation, which confirmed it was comprehensible. After that, the questionnaire was disseminated to 10 nurses to assess the validity and reliability using the bivariate correlation test and alpha-cronbach reliability test.

The resuscitation knowledge questionnaire contained 25 statements which are true or false questions. The participants chose the answer by marking either "true" or "false" in the column provided. The correct answer mark is 1 point and the wrong answer mark is 0 point. We obtained the total score for each subject for further analysis. From the 148 respondents, we excluded 25 participants because they did not meet our criteria. Five respondents were excluded because they do not work at a type A to D hospital. A further 20 respondents were excluded because they were co-assistant. Leaving 123 respondents included for the knowledge analysis in this study.

The resuscitation experience questionnaire contained 23 statements regarding neonatal resuscitation. The participants were asked to choose an answer using a Likert scale from one to five indicating from rarely to often doing the job in the statement. The data from each subject was then totaled for further analysis. From the 89 respondents who filled out the experience questionnaire, 19 respondents were excluded because they did not meet our criteria. Three respondents did not work at a type A to D hospital and 16 respondents were co-assistants. Leaving 70 respondents for the resuscitation experience analysis.

### Definitions

Type A–D hospitals are defined by the Regulation of the Minister of Health of the Republic of Indonesia No. 340/MENKES/PER/III/2010.<sup>21</sup> The hospital type is classified based on the medical service facilities and their capabilities. For the type A hospitals there must be at least 4 Basic Specialists, 5 Medical Support Specialists, 12 Other Specialists and 13 Sub Specialist Services. Type B hospitals must have at least 4 Basic Specialists, 4 Medical Support

Specialists, 8 Other Specialists and 2 Subspecialist Services. Type C hospitals must have at least 4 Basic Specialists and 4 Medical Supporting Specialist Services. Type D hospitals must have at least 2 Basic Specialist Medical Services.

According to the American Academy of Pediatrics (AAP),<sup>22</sup> work units in neonatal care are divided into four levels, namely level 1 to level 4. Level 1 is usually carried out to stabilize the condition of term infants with physiologically stable conditions. Level 2 work units are responsible for stabilizing the premature infants and term infants who are physiologically ill. While at level 3, it is necessary to carry out continuous infant stabilization and observation.<sup>22</sup> Although there are four levels, in this study we only divided the room into 3 levels. The level 1 consists of the emergency room, baby room, or neonate room, the level 2 consists of a perinatology room, and the level 3 were Neonatal Intensive Care Unit (NICU) or Pediatric Intensive Care Unit (PICU).

### Statistical analysis

We provide tables for each answered question for the knowledge and experience questionnaire. For analysis, we use the average of the total knowledge and experience for the comparative analysis. The continuous data was presented as median and interquartile range (IQR). The Mann-Whitney U test and Kruskal Wallis test were used to compare differences of total knowledge or experiences score between the groups for each factor. The Kruskal Wallis test was used for the multi-categorical data. The Mann-Whitney U test was used for the two-categorical data and the post-hoc analysis. Statistically significant was considered using two-sided  $\alpha$  less than 0.05. Statistical analysis was done using the IBM SPSS software (version 23, RRID:SCR\_016479).

## Results

### Study participant characteristics

The characteristics of the participants in the study are shown in [Table 1](#).<sup>47</sup> For the knowledge questionnaire, the participants mostly worked at type A hospitals (64.2%) and were mostly aged below 30 years. Only one participant was educated in master's degree and doctoral degree. The participating professions in this study were midwives (37.4%) and nurses (33.3%) and also dominated by women (91.1%). Most of the employees were contract workers, which consists of midwives, nurses, and general practitioners. For the experience questionnaire, the participants mostly worked at type A hospitals (48.6%). Most of the participant's professions were nurses (45.7%) and the participants were dominated by

**Table 1. Participant demography and characteristics.**

Characteristics		Knowledge measured		Resuscitation experience	
		N	%	N	%
Types of Hospital	A	79	64.2	34	48.6
	B	12	12.0	15	21.4
	C	20	16.3	14	20.0
	D	12	9.8	7	10.0
Sex	Male	11	8.9	10	14.3
	Female	112	91.1	60	85.7
Age	<30	69	56.1	27	38.6
	30-40	42	34.1	34	48.6
	40-50	10	8.1	8	11.4
	>50	2	1.6	1	1.4
Education	Associate Degree	67	54.5	26	37.1
	Bachelor Degree	54	43.9	42	60.0
	Master Degree	1	0.8	2	2.9
	Doctoral Degree	1	0.8	0	0.0
Type of Profession	Resident	27	22	23	32.9
	Midwife	46	37.4	6	8.6
	Nurse	41	33.3	32	45.7
	General Practitioners	9	7.3	9	12.9

**Table 1.** *Continued*

Characteristics		Knowledge measured		Resuscitation experience	
		N	%	N	%
Work Experience (Years)	<1	54	43.9	13	18.6
	1-5	26	21.1	24	34.3
	5-10	17	13.8	15	21.4
	10-15	11	8.9	7	10.0
	15-20	6	4.9	4	5.7
	>20	9	7.3	7	10.0
Employment Status	Permanent worker	33	26.8	28	40
	Contract worker	64	52.0	16	22.9
	Students	26	21.1	26	37.1
Unit Level	Level 1	64	52.0	24	34.29
	Level 2	4	3.25	5	7.14
	Level 3	55	44.72	41	58.57

females (85.7%). Most of the participants had bachelor's degrees (60%) and the permanent worker (40%) was the most common type of worker.

### Knowledge questionnaire

**Table 2** showed the answers for the knowledge questionnaire. The highest number participants chose false on the statement about chest compression initiation and positive pressure ventilation (87%). Statements about the number of heart rates in infants, infant diagnosis of primary or secondary apnea, the timing of oxygen administration, and the purpose of determining the Apgar score are also considered as hard questions with a high number of participants.

**Table 2. Answers of knowledge questionnaire.** ET: Endotracheal; HR: Heart Rate; PPV: Positive Pressure Ventilation.

No.	Questions	Answers	
		Correct N (%)	False N (%)
1	The size of the ET Tube that is suitable for babies weighing 2,800 grams is 2.5 mm	90 (73.2)	33 (26.8)
2	During chest compressions, the sternum should be pushed in 1.2 to 1.9 cm	72 (58.5)	51 (41.5)
3	Epinephrine administration should be started immediately if HR <60 or 0, with or without previous PPV	30 (24.4)	93 (75.6)
4	Chest compressions and ventilation are performed at least 60 seconds before the second HR evaluation is performed	96 (78.1)	27 (21.2)
5	An ET tube or a 6-F or 8-F suction catheter can be used to suck meconium from the trachea	87 (70.7)	36 (29.3)
6	Delayed drying of a respiratory depressed infant can be used to initiate resuscitation efforts.	98 (79.7)	25 (20.3)
7	PPV in neonates is carried out at a rate of 30-40 times per minute	60 (48.8)	63 (51.2)
8	An orogastric catheter should be inserted if the infant requires balloon and mask ventilation for more than a few minutes.	71 (58.8)	52 (42.3)
9	Chest compressions should be initiated only if the HR is below 60 beats per minute and positive pressure ventilation has been performed for 15-30 seconds	16 (13)	108 (87)
10	In infants showing respiratory effort, the heart rate should be at least 100 beats per minute	11 (9)	112 (91)
11	Poor response to resuscitation is a sign of hypovolemia in neonates	92 (74.8)	31 (25.2)

**Table 2.** *Continued*

No.	Questions	Answers	
		Correct N (%)	False N (%)
12	When oxygenating neonates with a mask or oxygen tube, the flowmeter should be set at a dose of 5 lpm	54 (43.9)	69 (56.1)
13	The volume of the mask balloon for neonates should not exceed 750ml	111 (90.2)	12 (9.8)
14	When sucking secretions during intubation, the suction pressure should not exceed -100mmHg	116 (94.3)	7 (5.7)
15	The neonate's nose should be suctioned before the mouth	58 (47.2)	65 (52.8)
16	Each attempt at intubation should be limited to no more than 30 seconds to minimize hypoxia	115 (93.5)	8 (6.5)
17	In neonates, respiratory depression due to narcotics is mostly caused by giving narcotics to the baby's mother within 4 hours before delivery	109 (88.6)	14 (11.4)
18	Expansion of the chest and the presence of breath sounds in both lung fields can be used as indicators of adequate ventilation	120 (97.6)	3 (2.4)
19	When a baby is not breathing at birth, it is very easy to determine whether the baby is primary or secondary apnea	40 (32.5)	83 (67.5)
20	Chest compressions are always accompanied by coordinated positive-pressure ventilation	34 (27.6)	89 (72.4)
21	When secondary apnea occurs, oxygen and stimulation will usually trigger breathing	28 (22.8)	95 (77.2)
22	If the baby's heart rate is >100 and the chest expands, but the baby still shows symptoms of central cyanosis, the most appropriate course of action is to initiate positive pressure ventilation with a mask or an ETT.	82 (66.7)	41 (33.3)
23	Placement of the ET tube can be confirmed by listening for breath sounds in both lung fields.	120 (97.6)	3 (2.4)
24	The APGAR score is used to determine when to start resuscitation and the goals of resuscitation	35 (28.5)	88 (71.5)
25	Complete resuscitation equipment should be available in the delivery room only when there is an indication of the need for resuscitation	114 (92.7)	9 (7.3)

We found a significant difference ( $p = 0.007$ ) between male (median 17.00; IQR 15.00–18.00) and female (median 15.00; IQR 14.00–16.00) participants as shown in [Table 3](#). The education and type of professional role are important factors on participants knowledge. The students (which is the same population as residents) (median 17.00; IQR 15.00–18.00) have higher knowledge than the permanent (median 15.00; IQR 13.00–16.50) and contract (median 15.00; IQR 15.00–15.00)

**Table 3.** Comparison between participants characteristic and knowledge score.

Characteristics		Total knowledge score		p-value
		Median	IQR	
Type of Hospital	A	15.00	15.00-16.00	0.119
	B	15.00	13.00-17.00	
	C	14.50	12.25-15.75	
	D	15.00	13.25-16.75	
Sex	Male	17.00	15.00-18.00	0.007*
	Female	15.00	14.00-16.00	
Age (Year)	<30	15.00	15.00-15.00	0.169
	30-40	15.00	13.75-17.00	
	40-50	16.00	14.75-17.25	
	>50	13.00	12.00-14.00	

**Table 3.** Continued

Characteristics		Total knowledge score		p-value
		Median	IQR	
Education	Associate Degree	15.00	14.00-15.00	0.009*
	Bachelor Degree	16.00	14.00-18.00	
	Master Degree	15.00	15.00-15.00	
	Doctoral Degree	18.00	18.00-18.00	
Type of Profession	Resident	17.00	15.00-18.00	0.000*
	Midwife	15.00	15.00-15.00	
	Nurse	14.00	12.50-16.00	
	General Practitioners	15.00	14.50-17.00	
Work Experience (Year)	<1	15.00	15.00-15.00	0.481
	1-5	16.00	13.75-18.00	
	5-10	15.00	13.00-16.50	
	10-15	14.00	13.00-18.00	
	15-20	14.50	12.75-16.00	
	>20	15.00	14.00-17.50	
Employment Status	Permanent worker	15.00	13.00-16.50	0.001*
	Contract worker	15.00	15.00-15.00	
	Students	17.00	15.00-18.00	
Unit Level	Level 1	15.00	15.00-15.00	0.410
	Level 2	13.50	10.50-16.50	
	Level 3	15.00	13.00-18.00	
Post Hoc Analysis				
Type of Hospital	A vs B		0.757	
	A vs C		0.013*	
	A vs D		0.463	
	B vs C		0.261	
	B vs D		0.799	
	C vs D		0.376	

\*p-value < 0.05.

workers ( $p = 0.001$ ). The post-hoc analysis showed a significant difference ( $p = 0.013$ ) of knowledge between the A type hospital (median 15.00; IQR 15.00–16.00) and the C type hospital (median 14.50; IQR 12.25–15.75).

### Experience questionnaire

The responses to the knowledge questionnaire were shown in Table 2. The majority of participants rarely performed pulse examinations on umbilical cord (40%). The study also revealed that several participants rarely perform endotracheal suctioning (35.7%), umbilical catheterization (34.3%), take blood through an umbilical vein catheter (47.1%), and administer drugs/fluids through an umbilical catheter (35.7%). Most of them were also not experienced in interpreting the results of neonates' blood gases (27/70; 38.6%) as shown in Table 4.

Table 5 showed the comparison between each group's risk factors on participant resuscitation experience. Types of hospital are associated with the experience of the medical profession ( $p = 0.026$ ) with type B as the highest experience option. In the post-hoc analysis, we know that there are non-significant differences between type A hospital and type B hospitals ( $p = 0.618$ ). The significant differences for the experience of the healthcare personnel are between A and D hospitals ( $p = 0.014$ ) and between B and D hospitals (0.007).

We also found a significant difference ( $p = 0.022$ ) between the ages, seemingly the older age have more experience on neonatal resuscitation. The type of profession also plays an important role in neonatal resuscitation ( $p = 0.002$ ).

**Table 4. Answers of experience questionnaire. PPV: Positive Pressure Ventilation.**

No	Questions	Answers N (%)				
		1	2	3	4	5
1.	Provide care to neonates after delivery	11 (15.7)	6 (8.6)	9 (12.9)	9 (12.9)	35 (50)
2.	Drying, positioning, and suctioning the neonate	9 (12.9)	5 (7.1)	8 (11.4)	15 (21.4)	33 (47.1)
3.	Performing suction on the neonate with a suction catheter	9 (12.9)	6 (8.6)	9 (12.9)	16 (22.9)	30 (42.9)
4.	Listening to the newborn's heart rate with a stethoscope	5 (7.1)	6 (8.6)	8 (11.4)	22 (31.4)	29 (41.4)
5.	Feel the pulse through the umbilical cord	28 (40)	11 (15.7)	19 (27.1)	8 (11.4)	4 (5.7)
6.	Turn on the infant warmer before labor begins	7 (10)	3 (4.3)	4 (5.7)	8 (11.4)	48 (68.6)
7.	Assessing the APGAR Score in fit newborns	4 (5.7)	4 (5.7)	9 (12.9)	11 (15.7)	42 (60)
8.	Assessing the APGAR Score in sick newborns	9 (12.9)	6 (8.6)	10 (14.3)	15 (21.4)	30 (42.9)
9.	Inserting an orogastric tube in the neonate	14 (20)	3 (4.3)	10 (14.3)	9 (12.9)	34 (48.6)
10.	Performing airway suctioning in neonates with a suction machine	10 (14.3)	3 (4.3)	6 (8.6)	18 (25.7)	33 (47.1)
11.	Performing endotracheal suctioning in infants with meconium membranes	25 (35.7)	8 (11.4)	13 (18.6)	12 (17.1)	12 (17.1)
12.	Performing PPV with balloons and masks	10 (14.3)	2 (2.9)	16 (22.9)	21 (30)	21 (30)
13.	Perform or assist endotracheal intubation	19 (27.1)	14 (20)	12 (17.1)	9 (12.9)	16 (22.9)
14.	Performing chest compression on the neonate	12 (17.1)	6 (8.6)	19 (27.1)	15 (21.4)	18 (25.7)
15.	Perform/assist umbilical catheter installation	24 (34.3)	9 (12.9)	17 (24.3)	7 (10)	13 (18.6)
16.	Taking blood through an umbilical vein catheter	33 (47.1)	4 (5.7)	16 (22.9)	6 (8.6)	11 (15.7)
17.	Administer medications/fluids through an umbilical catheter	25 (35.7)	9 (12.9)	9 (12.9)	9 (12.9)	18 (25.7)
18.	Interpreting the neonate's blood sugar level	9 (12.9)	7 (10)	11 (15.7)	16 (22.9)	27 (38.6)
19.	Interpreting neonatal blood gas results	27 (38.6)	9 (12.9)	12 (17.1)	10 (14.3)	12 (17.1)
20.	Communicating with family during resuscitation	11 (15.7)	6 (8.6)	15 (21.4)	13 (18.6)	25 (35.7)
21.	Communicating with family after resuscitation	6 (8.6)	8 (11.4)	8 (11.4)	13 (18.6)	35 (50)
22.	Provide emotional support to family during resuscitation	9 (12.9)	5 (7.1)	12 (17.1)	18 (25.7)	26 (37.1)
23.	Provide emotional support to family during resuscitation	7 (10)	3 (4.3)	9 (12.9)	21 (30)	30 (42.9)

**Table 5. Comparison between participants characteristic and experience score.**

Characteristics		Total experience score		p-value
		Median	IQR	
Types of Hospital	A	85.00	70.00-101.00	0.026*
	B	92.00	81.00-98.00	
	C	81.00	68.25-87.00	
	D	42.00	29.00-75.00	
Sex	Male	74.00	53.25-80.75	0.051
	Female	85.00	70.75-96.75	
Age (Year)	<30	75.00	42.00-86.00	0.022*
	30-40	85.00	72.25-101.00	
	40-50	91.00	81.50-94.50	
	>50	96.00	96.00-96.00	
Education	Associate Degree	85.00	73.75-93.00	0.453
	Bachelor Degree	83.00	55.75-100.75	
	Master Degree	65.00	60.00-70.00	
Type of Profession	Resident	83.00	70.00-111.00	0.002*
	Midwife	83.00	54.75-87.00	
	Nurse	89.50	78.75-96.00	
	General Practitioners	42.00	30.00-66.00	
Work Experience (Year)	<1	52.00	33.50-74.50	0.006*
	1-5	81.00	62.50-105.00	
	5-10	89.00	81.00-104.00	
	10-15	85.00	81.00-98.00	
	15-20	94.00	45.75-101.00	
	>20	90.00	81.00-95.00	
Employment Status	Permanent worker	87.50	78.75-95.75	0.230
	Contract worker	78.00	45.75-88.75	
	Students	77.50	52.00-105.75	
Unit Level	Level 1	74.00	42.00-84.50	0.002*
	Level 2	78.00	64.50-101.50	
	Level 3	92.00	76.00-99.00	
Post Hoc Analysis				
Type of Hospital	A vs B		0.618	
	A vs C		0.291	
	A vs D		0.014*	
	B vs C		0.073	
	B vs D		0.007*	
	C vs D		0.061	

\*p-value &lt; 0.05.

The nurses have the highest experience score (median 89.50; IQR 78.75–96.00) and the general practitioners have the lowest experience score (median 42.00; IQR 30.00–66.00). The longer work experience tended to have a higher experience score ( $p = 0.006$ ) and the second unit level was the unit level with the lowest experience score compared to the first and third level ( $p = 0.003$ ).

## Discussion

A high level of knowledge and experience of neonatal care is the key to the success of the resuscitation team.<sup>12,15,20</sup> Our study describes the knowledge and experience of the health care provider in tertiary hospitals in Indonesia. We found the readiness of healthcare personnel was associated with the type of hospital. We found that medical personnel in the type A hospital have better knowledge than the type C hospital. For the experience, the type A and type B hospitals showed more experienced healthcare personnel than the type D hospital. This study also reveals several factors that influence knowledge and experience. Hence, this study may be used as a reference in the neonatal resuscitation guidelines or policies.

Neonatal resuscitation is an action that requires decisive skill which is obtained by knowledge and experience.<sup>23</sup> The neonatal resuscitation team training must be conducted in sufficient time to ensure the capability for the healthcare personnel.<sup>11,23</sup> The availability of tools is also an important factor of hospital readiness to perform this procedure.<sup>13</sup> Type A or type B hospitals have more qualified facilities to perform the neonatal resuscitation. This is the reason why type A and type B hospitals have better experience in performing neonatal resuscitation than type D hospitals. This also indicates that neonatal resuscitation must be done at the type A or type B hospitals since they are more ready to perform the procedure.

Residents have the highest knowledge score among other types of professions. The students also have the highest knowledge score, since they mostly consist of residents. Knowledge of neonatal resuscitation is a competency that must be mastered by residents during their education as a prospective specialist.<sup>24,25</sup> Residents have the responsibility to plan treatment according to the patient's condition. Even with supervision, residents are actually expected to have extensive knowledge about the causes, diagnosis, prognosis, complication, and management of neonates.<sup>26,27</sup>

We found that nurses have the best experience scores among other types of professions. Nursing is a profession that is directly involved in providing services to the patients.<sup>16,28,29</sup> In the tertiary hospitals, where there are very large numbers of patients, doctors are often more involved in planning patient management. In this study, almost all general practitioners are young doctors, who just registered as the internship doctors. That may be the reason for their lack of experience. However, the right strategy needs to be implemented to improve the experience for general practitioners, since they will help in handling the newborns later.<sup>30</sup>

Previous studies have reported the relation between the age and the experience of neonatal resuscitation.<sup>18</sup> Experience will be gained after several times doing and practicing the procedure.<sup>31,32</sup> This is also the reason why work experience has a significant relation to the experience score. Experienced practitioners were found to be more confident in performing actions on neonatal patients.<sup>33,34</sup>

We found a significant difference between unit level and the total experience score. Higher unit levels have higher total experience scores. This is because at the level 1 unit, the baby being treated is a normal baby, while the higher level of care is related to more complications suffered by the babies.<sup>22,35</sup> The more difficult procedure may not be conducted at the unit level 1 and level 2, while this procedure is often held in the unit level 3.<sup>22</sup> However, we did not find any difference in knowledge between the three unit levels. Although most of the treatment in the level one unit is a normal baby, knowledge of signs of severity and early treatment is important at all levels.<sup>36</sup>

Additional training using The Newborn Resuscitation Manual from the United Kingdom with skill demonstrations and scenarios using mannequins have been proven to increase the level of knowledge of nurses, doctors, resident doctors, and specialists in Northern Nigeria.<sup>19</sup> To increase personal experience, the health care providers need to practice each step of resuscitation.<sup>37</sup> Routine training may be an important indicator in determining the hospital's readiness to conduct the neonatal resuscitation.<sup>38</sup> Training on the steps of neonatal resuscitation, especially in the steps of palpating umbilical cord pulse, endotracheal suctioning, endotracheal intubation, umbilical catheter placement, taking blood through an umbilical vein catheter, administering drugs/fluids through an umbilical catheter, and interpreting neonatal blood gas results, must be a concern and require more intense training since most of the research subjects in this study rarely perform them.<sup>39,40</sup>

Endotracheal intubation in neonates is rarely done because of the high level of difficulty and high risk of an adverse event for the procedure.<sup>40,41</sup> Even for the skilled healthcare personnel, sometimes they still need to do several attempts until the intubation can enter the trachea of the neonate.<sup>38,41</sup> The placement of an umbilical catheter, blood collection, and administration of drugs through the umbilical vein are rarely done, possibly because of its potential to be a risk factor of sepsis.<sup>42,43</sup> More practice with evaluation are needed to increase the healthcare personnel confidence in doing the neonatal resuscitation.<sup>44-46</sup>



## Research strengths and limitation

These findings may provide additional information to the guidelines of healthcare personnel training and qualifications. The participants joined this research voluntarily and were given brief socialization to make sure of the comprehension of the questionnaire to decrease risk of bias. However, several limitations exist in our study. First, the number of research subjects was reduced by the COVID-19 pandemic. We did consecutive sampling rather than random sampling which is more applicable. Second, we did not assess how many times the participants have joined the neonatal resuscitation training. The previous training may be associated with the knowledge and experience score of the participants.

## Conclusion

The success of neonatal resuscitation is influenced by the readiness of the hospital, which can be seen through indicators of the level of knowledge and experience of the healthcare personnel. In this study, we found that the healthcare personnel from type A and type B hospitals are more experienced than the type D hospital in conducting neonatal resuscitation. We suggest that the type D hospital or other primary care must refer the neonate if there is the need for neonatal resuscitation. Additional neonatal resuscitation training is necessary to increase the knowledge and experience of the healthcare personnel. Finally, larger observational studies with multi-center approaches need to be conducted to confirm our findings.

## Data availability

### Underlying data

Figshare: Neonatal Resuscitation: Measuring The Readiness of Healthcare Personnel, <https://doi.org/10.6084/m9.figshare.18865418>.<sup>47</sup>

The project contains the following underlying data:

- Experience.sav
- Knowledge.sav

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

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# Neonatal resuscitation A cross-sectional study measuring the readiness of healthcare personnel

*by Martono Tri Utomo*

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## RESEARCH ARTICLE

# Neonatal resuscitation: A cross-sectional study measuring the readiness of healthcare personnel [version 1; peer review: awaiting peer review]

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## Open Peer Review

**Approval Status** AWAITING PEER REVIEW

Any reports and responses or comments on the article can be found at the end of the article.

## Abstract

**Background:** The optimal neonatal resuscitation requires healthcare personnel knowledge and experience. This study aims to assess the readiness of hospitals through its healthcare personnel in performing neonatal resuscitation.

**Methods:** This study was an observational study conducted in May 2021 by distributing questionnaires to nurses, midwives, doctors, and residents to determine the level of knowledge and experience of the subject regarding neonatal resuscitation. We conducted the research in four types of hospitals A, B, C, and D, which are defined by the Regulation of the Minister of Health of the Republic of Indonesia by the capability and availability of medical services. The type A hospital is the hospital with the most complete medical services, while type D hospitals have the least medical services. The comparative analysis between participants' characteristics and the knowledge or experience score was conducted.

**Results:** The total 123 participants are included in the knowledge questionnaire analysis and 70 participants are included in the resuscitation experience analysis. We showed a significant difference ( $p = 0.013$ ) of healthcare personnel knowledge between the A type hospital (Median 15.00; Interquartile Range [IQR] 15.00–16.00) and the C type hospital (median 14.50; IQR 12.25–15.75). For the experience, the healthcare personnel of type A and type B hospitals have significantly higher experience scores than the type D hospital ( $p =$

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0.014;  $p = 0.007$ ), but we did not find a significant difference between others type of hospital comparison.

**Conclusions:** In this study, we found that the healthcare personnel from type A and type B hospitals are more experienced than the type D hospital in conducting neonatal resuscitation. We suggest more neonatal resuscitation training to improve the readiness of healthcare personnel from type C and type D hospital.

#### Keywords

Healthcare Personnel, Hospital, Neonate, Readiness, Resuscitation

1

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## Background

Neonatal mortality is one of the standards of neonatal care. Data from developing countries showed that about 4 million babies die in the neonatal period.<sup>1</sup> As a developing country, Indonesia also contributes, with the mortality rate reaching 12.4 per 1,000 live births in 2019.<sup>2</sup> The right strategy for neonatal referral and the readiness of the hospital must be assessed to decrease the neonatal mortality rate in Indonesia.<sup>3,4</sup>

The leading causes of neonatal mortality were prematurity, sepsis, and asphyxia.<sup>5-7</sup> These conditions are often related to the requirement of neonatal resuscitation.<sup>8,9</sup> Neonatal resuscitation is a series of procedures performed to prevent the morbidity and mortality associated with a hypoxic-ischemic tissue injury (brain, heart, kidney) and restore spontaneous breathing and adequate cardiac output.<sup>10,11</sup> The appropriate neonatal resuscitation is believed to increase the survival of neonates and reduce the mortality.<sup>12</sup>

The neonatal resuscitation service and patient prognosis were strong influence factors in the success of this procedure. Essential tools also must be available and ready to use whenever needed.<sup>11,13</sup> The healthcare personnel which play important roles on the neonatal resuscitation must be prepared by several trainings.<sup>14</sup> The trainings are expected to increase the healthcare personnel's capability and confidence in doing neonatal resuscitation.<sup>15</sup>

To provide optimal services, healthcare personnel must be prepared with both knowledge and experience.<sup>16-18</sup> Therefore, the factors that are associated with the knowledge and experience of the healthcare personnel need to be discovered. This study aims to assess the readiness of hospitals by analyzing the knowledge and experience of healthcare personnel in performing neonatal resuscitation.

## Methods

### Study design and participants

This research has obtained permission from the Ethics Committee of RSUD Dr. Soetomo Surabaya (Letter of Exemption 0335/LOE/301.4.2/II/2021). The data in this study was collected in May 2021 by distributing questionnaires to nurses, midwives, doctors, and residents to determine the level of knowledge and experience of the subject regarding neonatal resuscitation. The researchers met the participants and gave the explanation about the questionnaire in the pediatrics department of each hospital. Subjects in this study have filled out a statement of consent to be involved in this study. To address potential sources of bias, we invited respondents from all types of hospitals (A-D) to participate in our study.

### Data collection

This study was conducted in May 2021. The participants filled out the questionnaire for knowledge and experience measurement.<sup>19,20</sup> The questionnaire was adopted from Jukkala *et al.*<sup>20</sup> study with their permission. They developed questionnaires for measuring knowledge and experience in hospital settings. The questionnaires were then translated into Indonesian. The questionnaire was validated by several experts in neonatal resuscitation, which confirmed it was comprehensible. After that, the questionnaire was disseminated to 10 nurses to assess the validity and reliability using the bivariate correlation test and alpha-cronbach reliability test.

The resuscitation knowledge questionnaire contained 25 statements which are true or false questions. The participants chose the answer by marking either "true" or "false" in the column provided. The correct answer mark is 1 point and the wrong answer mark is 0 point. We obtained the total score for each subject for further analysis. From the 148 respondents, we excluded 25 participants because they did not meet our criteria. Five respondents were excluded because they do not work at a type A to D hospital. A further 20 respondents were excluded because they were co-assistant. Leaving 123 respondents included for the knowledge analysis in this study.

The resuscitation experience questionnaire contained 23 statements regarding neonatal resuscitation. The participants were asked to choose an answer using a Likert scale from one to five indicating from rarely to often doing the job in the statement. The data from each subject was then totaled for further analysis. From the 89 respondents who filled out the experience questionnaire, 19 respondents were excluded because they did not meet our criteria. Three respondents did not work at a type A to D hospital and 16 respondents were co-assistants. Leaving 70 respondents for the resuscitation experience analysis.

### Definitions

Type A–D hospitals are defined by the Regulation of the Minister of Health of the Republic of Indonesia No. 340/MENKES/PER/III/2010.<sup>21</sup> The hospital type is classified based on the medical service facilities and their capabilities. For the type A hospitals there must be at least 4 Basic Specialists, 5 Medical Support Specialists, 12 Other Specialists and 13 Sub Specialist Services. Type B hospitals must have at least 4 Basic Specialists, 4 Medical Support

Specialists, 8 Other Specialists and 2 Subspecialist Services. Type C hospitals must have at least 4 Basic Specialists and 4 Medical Supporting Specialist Services. Type D hospitals must have at least 2 Basic Specialist Medical Services.

According to the American Academy of Pediatrics (AAP),<sup>23</sup> work units in neonatal care are divided into four levels, namely level 1 to level 4. Level 1 is usually carried out to stabilize the condition of term infants with physiologically stable conditions. Level 2 work units are responsible for stabilizing the premature infants and term infants who are physiologically ill. While at level 3, it is necessary to carry out continuous infant stabilization and observation.<sup>23</sup> Although there are four levels, in this study we only divided the room into 3 levels. The level 1 consists of the emergency room, baby room, or neonate room, the level 2 consists of a perinatology room, and the level 3 were Neonatal Intensive Care Unit (NICU) or Pediatric Intensive Care Unit (PICU).

### Statistical analysis

We provide tables for each answered question for the knowledge and experience questionnaire. For analysis, we use the average of the total knowledge and experience for the comparative analysis. The continuous data was presented as median and interquartile range (IQR). The Mann-Whitney U test and Kruskal Wallis test were used to compare differences of total knowledge or experiences score between the groups for each factor. The Kruskal Wallis test was used for the multi-categorical data. The Mann-Whitney U test was used for the two-categorical data and the post-hoc analysis. Statistically significant was considered using two-sided  $\alpha$  less than 0.05. Statistical analysis was done using the IBM SPSS software (version 23, RRID:SCR\_016479).

## Results

### Study participant characteristics

The characteristics of the participants in the study are shown in Table 1.<sup>47</sup> For the knowledge questionnaire, the participants mostly worked at type A hospitals (64.2%) and were mostly aged below 30 years. Only one participant was educated in master's degree and doctoral degree. The participating professions in this study were midwives (37.4%) and nurses (33.3%) and also dominated by women (91.1%). Most of the employees were contract workers, which consists of midwives, nurses, and general practitioners. For the experience questionnaire, the participants mostly worked at type A hospitals (48.6%). Most of the participant's professions were nurses (45.7%) and the participants were dominated by

**Table 1. Participant demography and characteristics.**

Characteristics		Knowledge measured		Resuscitation experience	
		N	%	N	%
Types of Hospital	A	79	64.2	34	48.6
	B	12	12.0	15	21.4
	C	20	16.3	14	20.0
	D	12	9.8	7	10.0
Sex	Male	11	8.9	10	14.3
	Female	112	91.1	60	85.7
Age	<30	69	56.1	27	38.6
	30-40	42	34.1	34	48.6
	40-50	10	8.1	8	11.4
	>50	2	1.6	1	1.4
Education	Associate Degree	67	54.5	26	37.1
	Bachelor Degree	54	43.9	42	60.0
	Master Degree	1	0.8	2	2.9
	Doctoral Degree	1	0.8	0	0.0
Type of Profession	Resident	27	22	23	32.9
	Midwife	46	37.4	6	8.6
	Nurse	41	33.3	32	45.7
	General Practitioners	9	7.3	9	12.9



**Table 1.** *Continued*

Characteristics		Knowledge measured		Resuscitation experience	
		N	%	N	%
Work Experience (Years)	<1	54	43.9	13	18.6
	1-5	26	21.1	24	34.3
	5-10	17	13.8	15	21.4
	10-15	11	8.9	7	10.0
	15-20	6	4.9	4	5.7
	>20	9	7.3	7	10.0
Employment Status	Permanent worker	33	26.8	28	40
	Contract worker	64	52.0	16	22.9
	Students	26	21.1	26	37.1
Unit Level	Level 1	64	52.0	24	34.29
	Level 2	4	3.25	5	7.14
	Level 3	55	44.72	41	58.57

females (85.7%). Most of the participants had bachelor's degrees (60%) and the permanent worker (40%) was the most common type of worker.

#### Knowledge questionnaire

Table 2 showed the answers for the knowledge questionnaire. The highest number participants chose false on the statement about chest compression initiation and positive pressure ventilation (87%). Statements about the number of heart rates in infants, infant diagnosis of primary or secondary apnea, the timing of oxygen administration, and the purpose of determining the Apgar score are also considered as hard questions with a high number of participants.

**Table 2. Answers of knowledge questionnaire.** ET: Endotracheal; HR: Heart Rate; PPV: Positive Pressure Ventilation.

No.	Questions	Answers	
		Correct N (%)	False N (%)
1	The size of the ET Tube that is suitable for babies weighing 2,800 grams is 2.5 mm	90 (73.2)	33 (26.8)
2	During chest compressions, the sternum should be pushed in 1.2 to 1.9 cm	72 (58.5)	51 (41.5)
3	Epinephrine administration should be started immediately if HR <60 or 0, with or without previous PPV	30 (24.4)	93 (75.6)
4	Chest compressions and ventilation are performed at least 60 seconds before the second HR evaluation is performed	96 (78.1)	27 (21.2)
5	An ET tube or a 6-F or 8-F suction catheter can be used to suck meconium from the trachea	87 (70.7)	36 (29.3)
6	Delayed drying of a respiratory depressed infant can be used to initiate resuscitation efforts.	98 (79.7)	25 (20.3)
7	PPV in neonates is carried out at a rate of 30-40 times per minute	60 (48.8)	63 (51.2)
8	An orogastric catheter should be inserted if the infant requires balloon and mask ventilation for more than a few minutes.	71 (58.8)	52 (42.3)
9	Chest compressions should be initiated only if the HR is below 60 beats per minute and positive pressure ventilation has been performed for 15-30 seconds	16 (13)	108 (87)
10	In infants showing respiratory effort, the heart rate should be at least 100 beats per minute	11 (9)	112 (91)
11	Poor response to resuscitation is a sign of hypovolemia in neonates	92 (74.8)	31 (25.2)

**Table 2.** *Continued*

No.	Questions	Answers	
		Correct N (%)	False N (%)
12	When oxygenating neonates with a mask or oxygen tube, the flowmeter should be set at a dose of 5 lpm	54 (43.9)	69 (56.1)
13	The volume of the mask balloon for neonates should not exceed 750ml	111 (90.2)	12 (9.8)
14	When sucking secretions during intubation, the suction pressure should not exceed -100mmHg	116 (94.3)	7 (5.7)
15	The neonate's nose should be suctioned before the mouth	58 (47.2)	65 (52.8)
16	Each attempt at intubation should be limited to no more than 30 seconds to minimize hypoxia	115 (93.5)	8 (6.5)
17	In neonates, respiratory depression due to narcotics is mostly caused by giving narcotics to the baby's mother within 4 hours before delivery	109 (88.6)	14 (11.4)
18	Expansion of the chest and the presence of breath sounds in both lung fields can be used as indicators of adequate ventilation	120 (97.6)	3 (2.4)
19	When a baby is not breathing at birth, it is very easy to determine whether the baby is primary or secondary apnea	40 (32.5)	83 (67.5)
20	Chest compressions are always accompanied by coordinated positive-pressure ventilation	34 (27.6)	89 (72.4)
21	When secondary apnea occurs, oxygen and stimulation will usually trigger breathing	28 (22.8)	95 (77.2)
22	If the baby's heart rate is >100 and the chest expands, but the baby still shows symptoms of central cyanosis, the most appropriate course of action is to initiate positive pressure ventilation with a mask or an ETT.	82 (66.7)	41 (33.3)
23	Placement of the ET tube can be confirmed by listening for breath sounds in both lung fields.	120 (97.6)	3 (2.4)
24	The APGAR score is used to determine when to start resuscitation and the goals of resuscitation	35 (28.5)	88 (71.5)
25	Complete resuscitation equipment should be available in the delivery room only when there is an indication of the need for resuscitation	114 (92.7)	9 (7.3)

We found a significant difference ( $p = 0.007$ ) between male (median 17.00; IQR 15.00–18.00) and female (median 15.00; IQR 14.00–16.00) participants as shown in Table 3. The education and type of professional role are important factors on participants knowledge. The students (which is the same population as residents) (median 17.00; IQR 15.00–18.00) have higher knowledge than the permanent (median 15.00; IQR 13.00–16.50) and contract (median 15.00; IQR 15.00–15.00)

**Table 3.** Comparison between participants characteristic and knowledge score.

Characteristics		Total knowledge score		p-value
		Median	IQR	
Type of Hospital	A	15.00	15.00-16.00	0.119
	B	15.00	13.00-17.00	
	C	14.50	12.25-15.75	
	D	15.00	13.25-16.75	
Sex	Male	17.00	15.00-18.00	0.007*
	Female	15.00	14.00-16.00	
Age (Year)	<30	15.00	15.00-15.00	0.169
	30-40	15.00	13.75-17.00	
	40-50	16.00	14.75-17.25	
	>50	13.00	12.00-14.00	

Table 3. Continued

Characteristics		Total knowledge score		p-value
		Median	IQR	
Education	Associate Degree	15.00	14.00-15.00	0.009*
	Bachelor Degree	16.00	14.00-18.00	
	Master Degree	15.00	15.00-15.00	
	Doctoral Degree	18.00	18.00-18.00	
Type of Profession	Resident	17.00	15.00-18.00	0.000*
	Midwife	15.00	15.00-15.00	
	Nurse	14.00	12.50-16.00	
	General Practitioners	15.00	14.50-17.00	
Work Experience (Year)	<1	15.00	15.00-15.00	0.481
	1-5	16.00	13.75-18.00	
	5-10	15.00	13.00-16.50	
	10-15	14.00	13.00-18.00	
	15-20	14.50	12.75-16.00	
	>20	15.00	14.00-17.50	
Employment Status	Permanent worker	15.00	13.00-16.50	0.001*
	Contract worker	15.00	15.00-15.00	
	Students	17.00	15.00-18.00	
Unit Level	Level 1	15.00	15.00-15.00	0.410
	Level 2	13.50	10.50-16.50	
	Level 3	15.00	13.00-18.00	
Post Hoc Analysis				
Type of Hospital	A vs B		0.757	
	A vs C		0.013*	
	A vs D		0.463	
	B vs C		0.261	
	B vs D		0.799	
	C vs D		0.376	

\*p-value &lt; 0.05.

workers ( $p = 0.001$ ). The post-hoc analysis showed a significant difference ( $p = 0.013$ ) of knowledge between the A type hospital (median 15.00; IQR 15.00–16.00) and the C type hospital (median 14.50; IQR 12.25–15.75).

### Experience questionnaire

The responses to the knowledge questionnaire were shown in Table 2. The majority of participants rarely performed pulse examinations on umbilical cord (40%). The study also revealed that several participants rarely perform endotracheal suctioning (35.7%), umbilical catheterization (34.3%), take blood through an umbilical vein catheter (47.1%), and administer drugs/fluids through an umbilical catheter (35.7%). Most of them were also not experienced in interpreting the results of neonates' blood gases (27/70; 38.6%) as shown in Table 4.

Table 5 showed the comparison between each group's risk factors on participant resuscitation experience. Types of hospital are associated with the experience of the medical profession ( $p = 0.026$ ) with type B as the highest experience option. In the post-hoc analysis, we know that there are non-significant differences between type A hospital and type B hospitals ( $p = 0.618$ ). The significant differences for the experience of the healthcare personnel are between A and D hospitals ( $p = 0.014$ ) and between B and D hospitals (0.007).

We also found a significant difference ( $p = 0.022$ ) between the ages, seemingly the older age have more experience on neonatal resuscitation. The type of profession also plays an important role in neonatal resuscitation ( $p = 0.002$ ).

**Table 4. Answers of experience questionnaire. PPV: Positive Pressure Ventilation.**

No	Questions	Answers N (%)				
		1	2	3	4	5
1.	Provide care to neonates after delivery	11 (15.7)	6 (8.6)	9 (12.9)	9 (12.9)	35 (50)
2.	Drying, positioning, and suctioning the neonate	9 (12.9)	5 (7.1)	8 (11.4)	15 (21.4)	33 (47.1)
3.	Performing suction on the neonate with a suction catheter	9 (12.9)	6 (8.6)	9 (12.9)	16 (22.9)	30 (42.9)
4.	Listening to the newborn's heart rate with a stethoscope	5 (7.1)	6 (8.6)	8 (11.4)	22 (31.4)	29 (41.4)
5.	Feel the pulse through the umbilical cord	28 (40)	11 (15.7)	19 (27.1)	8 (11.4)	4 (5.7)
6.	Turn on the infant warmer before labor begins	7 (10)	3 (4.3)	4 (5.7)	8 (11.4)	48 (68.6)
7.	Assessing the APGAR Score in fit newborns	4 (5.7)	4 (5.7)	9 (12.9)	11 (15.7)	42 (60)
8.	Assessing the APGAR Score in sick newborns	9 (12.9)	6 (8.6)	10 (14.3)	15 (21.4)	30 (42.9)
9.	Inserting an orogastric tube in the neonate	14 (20)	3 (4.3)	10 (14.3)	9 (12.9)	34 (48.6)
10.	Performing airway suctioning in neonates with a suction machine	10 (14.3)	3 (4.3)	6 (8.6)	18 (25.7)	33 (47.1)
11.	Performing endotracheal suctioning in infants with meconium membranes	25 (35.7)	8 (11.4)	13 (18.6)	12 (17.1)	12 (17.1)
12.	Performing PPV with balloons and masks	10 (14.3)	2 (2.9)	16 (22.9)	21 (30)	21 (30)
13.	Perform or assist endotracheal intubation	19 (27.1)	14 (20)	12 (17.1)	9 (12.9)	16 (22.9)
14.	Performing chest compression on the neonate	12 (17.1)	6 (8.6)	19 (27.1)	15 (21.4)	18 (25.7)
15.	Perform/assist umbilical catheter installation	24 (34.3)	9 (12.9)	17 (24.3)	7 (10)	13 (18.6)
16.	Taking blood through an umbilical vein catheter	33 (47.1)	4 (5.7)	16 (22.9)	6 (8.6)	11 (15.7)
17.	Administer medications/fluids through an umbilical catheter	25 (35.7)	9 (12.9)	9 (12.9)	9 (12.9)	18 (25.7)
18.	Interpreting the neonate's blood sugar level	9 (12.9)	7 (10)	11 (15.7)	16 (22.9)	27 (38.6)
19.	Interpreting neonatal blood gas results	27 (38.6)	9 (12.9)	12 (17.1)	10 (14.3)	12 (17.1)
20.	Communicating with family during resuscitation	11 (15.7)	6 (8.6)	15 (21.4)	13 (18.6)	25 (35.7)
21.	Communicating with family after resuscitation	6 (8.6)	8 (11.4)	8 (11.4)	13 (18.6)	35 (50)
22.	Provide emotional support to family during resuscitation	9 (12.9)	5 (7.1)	12 (17.1)	18 (25.7)	26 (37.1)
23.	Provide emotional support to family during resuscitation	7 (10)	3 (4.3)	9 (12.9)	21 (30)	30 (42.9)

**Table 5. Comparison between participants characteristic and experience score.**

Characteristics		Total experience score		p-value
		Median	IQR	
Types of Hospital	A	85.00	70.00-101.00	0.026*
	B	92.00	81.00-98.00	
	C	81.00	68.25-87.00	
	D	42.00	29.00-75.00	
Sex	Male	74.00	53.25-80.75	0.051
	Female	85.00	70.75-96.75	
Age (Year)	<30	75.00	42.00-86.00	0.022*
	30-40	85.00	72.25-101.00	
	40-50	91.00	81.50-94.50	
	>50	96.00	96.00-96.00	
Education	Associate Degree	85.00	73.75-93.00	0.453
	Bachelor Degree	83.00	55.75-100.75	
	Master Degree	65.00	60.00-70.00	
Type of Profession	Resident	83.00	70.00-111.00	0.002*
	Midwife	83.00	54.75-87.00	
	Nurse	89.50	78.75-96.00	
	General Practitioners	42.00	30.00-66.00	
Work Experience (Year)	<1	52.00	33.50-74.50	0.006*
	1-5	81.00	62.50-105.00	
	5-10	89.00	81.00-104.00	
	10-15	85.00	81.00-98.00	
	15-20	94.00	45.75-101.00	
	>20	90.00	81.00-95.00	
Employment Status	Permanent worker	87.50	78.75-95.75	0.230
	Contract worker	78.00	45.75-88.75	
	Students	77.50	52.00-105.75	
Unit Level	Level 1	74.00	42.00-84.50	0.002*
	Level 2	78.00	64.50-101.50	
	Level 3	92.00	76.00-99.00	
Post Hoc Analysis				
Type of Hospital	A vs B	0.618		0.003*
	A vs C	0.291		
	A vs D	0.014*		
	B vs C	0.073		
	B vs D	0.007*		
	C vs D	0.061		

\*p-value &lt; 0.05.

The nurses have the highest experience score (median 89.50; IQR 78.75–96.00) and the general practitioners have the lowest experience score (median 42.00; IQR 30.00–66.00). The longer work experience tended to have a higher experience score ( $p = 0.006$ ) and the second unit level was the unit level with the lowest experience score compared to the first and third level ( $p = 0.003$ ).

## Discussion

A high level of knowledge and experience of neonatal care is the key to the success of the resuscitation team.<sup>12,15,20</sup> Our study describes the knowledge and experience of the health care provider in tertiary hospitals in Indonesia. We found the readiness of healthcare personnel was associated with the type of hospital. We found that medical personnel in the type A hospital have better knowledge than the type C hospital. For the experience, the type A and type B hospitals showed more experienced healthcare personnel than the type D hospital. This study also reveals several factors that influence knowledge and experience. Hence, this study may be used as a reference in the neonatal resuscitation guidelines or policies.

Neonatal resuscitation is an action that requires decisive skill which is obtained by knowledge and experience.<sup>23</sup> The neonatal resuscitation team training must be conducted in sufficient time to ensure the capability for the healthcare personnel.<sup>11,23</sup> The availability of tools is also an important factor of hospital readiness to perform this procedure.<sup>13</sup> Type A or type B hospitals have more qualified facilities to perform the neonatal resuscitation. This is the reason why type A and type B hospitals have better experience in performing neonatal resuscitation than type D hospitals. This also indicates that neonatal resuscitation must be done at the type A or type B hospitals since they are more ready to perform the procedure.

Residents have the highest knowledge score among other types of professions. The students also have the highest knowledge score, since they mostly consist of residents. Knowledge of neonatal resuscitation is a competency that must be mastered by residents during their education as a prospective specialist.<sup>24,25</sup> Residents have the responsibility to plan treatment according to the patient's condition. Even with supervision, residents are actually expected to have extensive knowledge about the causes, diagnosis, prognosis, complication, and management of neonates.<sup>26,27</sup>

We found that nurses have the best experience scores among other types of professions. Nursing is a profession that is directly involved in providing services to the patients.<sup>16,28,29</sup> In the tertiary hospitals, where there are very large numbers of patients, doctors are often more involved in planning patient management. In this study, almost all general practitioners are young doctors, who just registered as the internship doctors. That may be the reason for their lack of experience. However, the right strategy needs to be implemented to improve the experience for general practitioners, since they will help in handling the newborns later.<sup>30</sup>

Previous studies have reported the relation between the age and the experience of neonatal resuscitation.<sup>18</sup> Experience will be gained after several times doing and practicing the procedure.<sup>31,32</sup> This is also the reason why work experience has a significant relation to the experience score. Experienced practitioners were found to be more confident in performing actions on neonatal patients.<sup>33,34</sup>

We found a significant difference between unit level and the total experience score. Higher unit levels have higher total experience scores. This is because at the level 1 unit, the baby being treated is a normal baby, while the higher level of care is related to more complications suffered by the babies.<sup>22,35</sup> The more difficult procedure may not be conducted at the unit level 1 and level 2, while this procedure is often held in the unit level 3.<sup>22</sup> However, we did not find any difference in knowledge between the three unit levels. Although most of the treatment in the level one unit is a normal baby, knowledge of signs of severity and early treatment is important at all levels.<sup>36</sup>

Additional training using The Newborn Resuscitation Manual from the United Kingdom with skill demonstrations and scenarios using mannequins have been proven to increase the level of knowledge of nurses, doctors, resident doctors, and specialists in Northern Nigeria.<sup>19</sup> To increase personal experience, the health care providers need to practice each step of resuscitation.<sup>37</sup> Routine training may be an important indicator in determining the hospital's readiness to conduct the neonatal resuscitation.<sup>38</sup> Training on the steps of neonatal resuscitation, especially in the steps of palpating umbilical cord pulse, endotracheal suctioning, endotracheal intubation, umbilical catheter placement, taking blood through an umbilical vein catheter, administering drugs/fluids through an umbilical catheter, and interpreting neonatal blood gas results, must be a concern and require more intense training since most of the research subjects in this study rarely perform them.<sup>39,40</sup>

Endotracheal intubation in neonates is rarely done because of the high level of difficulty and high risk of an adverse event for the procedure.<sup>40,41</sup> Even for the skilled healthcare personnel, sometimes they still need to do several attempts until the intubation can enter the trachea of the neonate.<sup>38,41</sup> The placement of an umbilical catheter, blood collection, and administration of drugs through the umbilical vein are rarely done, possibly because of its potential to be a risk factor of sepsis.<sup>42,43</sup> More practice with evaluation are needed to increase the healthcare personnel confidence in doing the neonatal resuscitation.<sup>44-46</sup>

### Research strengths and limitation

These findings may provide additional information to the guidelines of healthcare personnel training and qualifications. The participants joined this research voluntarily and were given brief socialization to make sure of the comprehension of the questionnaire to decrease risk of bias. However, several limitations exist in our study. First, the number of research subjects was reduced by the COVID-19 pandemic. We did consecutive sampling rather than random sampling which is more applicable. Second, we did not assess how many times the participants have joined the neonatal resuscitation training. The previous training may be associated with the knowledge and experience score of the participants.

### Conclusion

The success of neonatal resuscitation is influenced by the readiness of the hospital, which can be seen through indicators of the level of knowledge and experience of the healthcare personnel. In this study, we found that the healthcare personnel from type A and type B hospitals are more experienced than the type D hospital in conducting neonatal resuscitation. We suggest that the type D hospital or other primary care must refer the neonate if there is the need for neonatal resuscitation. Additional neonatal resuscitation training is necessary to increase the knowledge and experience of the healthcare personnel. Finally, larger observational studies with multi-center approaches need to be conducted to confirm our findings.

### Data availability

#### Underlying data

Figshare: Neonatal Resuscitation: Measuring The Readiness of Healthcare Personnel, <https://doi.org/10.6084/m9.figshare.18865418>.<sup>47</sup>

The project contains the following underlying data:

- Experience.sav
- Knowledge.sav

Data are available under the terms of the [Creative Commons Attribution 4.0 International license \(CC-BY 4.0\)](https://creativecommons.org/licenses/by/4.0/).

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