KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

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Aircraft Serious Incident Investigation Report

PT Citilink Indonesia

Airbus A320-200; PK-GLW

Near Juanda Airport, Surabaya

Republic of Indonesia

21 July 2022

2025

This Final Report is published by the Komite Nasional Keselamatan Transportasi (KNKT), Transportation Building, 3rd Floor, Jalan Medan Merdeka Timur No. 5 Jakarta 10110, Indonesia.

The report is based upon the investigation carried out by the KNKT in accordance with Annex 13 to the Convention on International Civil Aviation, the Indonesian Aviation Act (UU No. 1/2009) and Government Regulation (PP No. 62/2013).

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Jakarta, 2 September 2025
KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN

SOERJANTO TJAHJONO

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ABBREVIATIONS AND DEFINITIONS

AHA	:	American Heart Association
AME	:	Aviation Medical Examiner
APP	:	Approach
APU	:	Auxiliary Power Unit
ARFF	:	Airport Rescue and Fire Fighting
ATPL	:	Airline Transport Pilot License
CAD	:	Coronary Artery Disease
CASR	:	Civil Aviation Safety Regulation
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of Registration
CDC	:	Centers for Disease Control and Prevention
CPL	:	Commercial Pilot License
CPR	:	Cardiopulmonary Resuscitation
CT	:	Computed Tomography
CTR	:	Control Zone
CVD	:	Cardiovascular Disease
CVR	:	Cockpit Voice Recorder
DGCA	:	Directorate General of Civil Aviation
ECAM	:	Electronic Centralized Aircraft Monitoring
ECG	:	Electrocardiogram
EMK	:	Emergency Medical Kit
FA	:	Flight Attendant
FAC	:	Flight Attendant Certificate
FCOM	:	Flight Crew Operating Manual
FDR	:	Flight Data Recorder
FFS	:	Full Flight Simulator
FL	:	Flight Level
FRS	:	Framingham Risk Score
GCS	:	Glasgow Coma Scale
HDL-C	:	High Density Lipoprotein Cholesterol
HR	:	Heart Rate
ILS	:	Instrument Landing System
KNKT	:	*Komite Nasional Keselamatan Transportasi*
LBBB	:	Left Bundle Branch Block
LDL-C	:	Low Density Lipoprotein Cholesterol

LT	:	Local Time
METs	:	Metabolic Equivalents
OM-A	:	Operation Manual Part A
OM-B2	:	Operation Manual Part B2
OM-D	:	Operation Manual Part D
PA	:	Public Address system
pb	:	Push button
PF	:	Pilot Flying
PIC	:	Pilot in Command
PM	:	Pilot Monitoring
RNP	:	Required Navigation Performance
SI	:	Staff Instruction
SIC	:	Second in Command
TC	:	Total Cholesterol
TG	:	Triglycerides
TMA	:	Terminal Control Area
TWR	:	Tower Controller
UTC	:	Universal Time Coordinated

SYNOPSIS

On 21 July 2022, an Airbus A320-200 aircraft, registered PK-GLW was operated by PT Citilink Indonesia on a scheduled passenger flight from Juanda International Airport (WARR), Surabaya to Sultan Hasanuddin International Airport (WAAA), Makassar with flight number CTV307.

Prior to the flight, both pilots underwent alcohol, blood pressure and oxygen saturation tests, and the result for both pilots were normal. During the flight preparation, the Pilot in Command (PIC) conducted a pre-flight briefing for all crew members in the aircraft. There was no report of health issues among the crew members or aircraft abnormality.

The flight consisted of two pilots, four flight attendants, and 171 passengers. The PIC acted as the Pilot Monitoring (PM) and the Second in Command (SIC) acted as the Pilot Flying (PF).

At 2315 UTC (0615 LT), in daylight condition, the aircraft departed Surabaya. A minute after takeoff, the SIC noticed the PIC was in a rigid position. The SIC attempted to check the PIC's consciousness, but there was no response. Thereafter, the SIC advised the FA of the PIC incapacitation. The FA made an announcement to seek any medical doctor or paramedic onboard and type of qualified pilot onboard. A medical doctor showed up and the FA took the medical doctor to the cockpit, however there was no type of qualified pilot onboard among the passengers.

The physical examination on the PIC which was conducted by a medical doctor during the occurrence flight found that the PIC was pulseless followed by no breathing. There was no sign of stomach illness, respiratory problem, or neurological problem. The medical doctor suspected the PIC had a heart attack or stroke.

At 0620 LT, the SIC declared an urgency message (PAN PAN) to TMA controller and requested for returning to Surabaya due to one pilot incapacitation. At 0656 LT, the aircraft landed on Runway 10. Considering that the PIC required immediate medical treatment, the SIC decided to vacate the runway and continued taxi to the parking stand. After the aircraft stopped at the parking stand and the forward cabin door was opened, the medical personnel of the airport entered the aircraft to examine the PIC condition. The PIC then transported to a hospital. Afterward, the passengers disembarked the aircraft. The PIC was pronounced deceased upon arrival at the hospital, and the time of death was unknown.

The investigation concluded that the absence of a further and fuller review to clarify the anomaly indication during the last resting ECG, the duration of exercise ECG which was less than nine minutes, and the absence of a heart computed tomography (CT) scan during the last medical examination resulted in a loss opportunity to have a more comprehensive review of the PIC's cardiovascular condition. In addition, the possibility of cardiovascular events resulting from inadequate intervention measures to mitigate vascular risk factors might have rendered the PIC's incapacitation.

During the investigation, the Komite Nasional Keselamatan Transportasi (KNKT) had been informed of several safety actions taken by the Directorate General of Civil Aviation (DGCA) and the aircraft operator. KNKT acknowledged that the safety actions were relevant to improving safety, however there are still safety issues remaining to be considered. Therefore, the KNKT issued safety recommendations to the aircraft operator, Aviation Medical Center and DGCA to address the safety issues.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 21 July 2022, an Airbus A320-200 aircraft, registered PK-GLW was being operated by PT Citilink Indonesia (Citilink) on a scheduled passenger flight from Juanda International Airport (WARR), Surabaya[1] with an intended destination of Sultan Hasanuddin International Airport (WAAA), Makassar under flight number CTV307. The crew consisted of two pilots and four flight attendants.

Prior to the flight, both pilots underwent alcohol, blood pressure and oxygen saturation tests. The results of the tests for both pilots were normal[2]. The Pilot in Command (PIC) had a blood pressure of 120/80 mmHg and an oxygen saturation of 98%, while the Second in Command (SIC) had a blood pressure of 110/80 mmHg and an oxygen saturation of 99%. During the flight preparation, the PIC conducted a pre-flight briefing for all crew members in the aircraft.

The flight was the first flight of the day for both pilots. Prior to departure, there was no report of health issues of the crew or aircraft abnormality.

At 2315 UTC (0615 LT[3]), in daylight condition, the aircraft departed from Runway 28 Surabaya with a total of 171 passengers on board. A few seconds after airborne, the autopilot was engaged.

The PIC acted as Pilot Monitoring (PM), and the SIC acted as Pilot Flying (PF). The aircraft took off in a packs off take off configuration[4]. After takeoff, the Surabaya Tower controller (TWR controller) instructed the pilot to contact the Surabaya Approach controller on frequency 125.1 MHz for subsequent air traffic services provided by Terminal Control Area (TMA) controller[5] by utilizing surveillance system (radar service).

The PIC made initial contact with the TMA controller and was instructed to climb to Flight Level (FL) 230 (altitude of 23,000 feet) and proceed directly to Waypoint PEDSO[6]. The PIC requested the controller to repeat the name of the waypoint, after which the TMA controller repeated the instruction to direct to Waypoint PEDSO. The PIC read back and relayed the instruction to the SIC.

At 0616 LT, when the aircraft was climbing past an altitude of 2,400 feet, an alert appeared on the Electronic Centralized Aircraft Monitoring (ECAM) showing that the Air Pack 2 was still in the off position. The SIC then called the PIC who was responsible for switching on the Air Pack 2 and saw the PIC was in a rigid position. The SIC then attempted to check the PIC's consciousness but there was no response which then made the SIC assume that the PIC had fainted.

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1 Juanda International Airport (WARR), Surabaya will be named as Surabaya for the purpose of this report.

2 Normal blood pressure is $\leq$ 140/90 mm Hg and normal oxygen saturation is 94-100% (World Health Organization)

3 The 24-hours clock in Local Time (LT) is used in this report to describe the local time as specific events occurred. Local time is Universal Time Coordinated (UTC)+7 hours.

4 Packs off take off configuration is the procedure on take-off by switching off the packs to close the bleed air supply from the engine to the aircraft air conditioning system in order to maximize the engine power.

5 Based on the active Notice to Airmen (NOTAM), between 1100 up to 2259 UTC, the approach control service within Surabaya Control Zone (CTR) and Terminal Control Area (TMA) was provided by TMA controller on frequency 125.1 MHz.

6 Waypoint PEDSO is located at coordinate 06°58'25"S 113°59'05"E, about 50 Nm from Runway 28.

At 0617 LT, the SIC contacted the Flight Attendant (FA) using the interphone requested the FA to come to the cockpit. The FA1 came to the cockpit, and the SIC informed that the PIC was incapacitated. The FA1 attempted to wake the PIC but was unsuccessful. The FA1 then left the cockpit, informed the FA3 that the PIC was incapacitated, and also asked FA3 to seek medical assistance from among the passengers.

The FA1 returned to the cockpit and brought an aromatherapy oil to rouse the PIC, assuming the PIC had fainted.

At 0619 LT, the SIC declared an urgency message (PAN PAN) to the aircraft operator ground personnel[7] using the company radio communication channel. The SIC informed the ground personnel that the PIC was incapacitated and planned to return to Surabaya. The aircraft operator ground personnel acknowledged the message.

At 0620 LT, the SIC declared an urgency message (PAN PAN) to TMA controller and requested for returning to Surabaya due to one pilot incapacitation. At this time, the aircraft had climbed to altitude of 13,000 feet. The TMA controller instructed the pilot of CTV307 (SIC) to proceed directly to Waypoint SADPU[8] and descend to altitude of 3,500 feet. About three minutes later, when the aircraft descended past altitude of 12,000 feet, the TMA controller instructed the SIC to hold over Waypoint SADPU for losing the aircraft altitude. The TMA controller also advised the CTV307 to report when ready to continue the landing approach. The SIC acknowledged the TMA controller instruction.

The FA3 made an announcement seeking medical personnel among the passengers and was responded by one of the passengers who claimed himself as a medical doctor. There were also two other passengers who claimed themselves as a medical doctor who then was advised by the FA that there was already a doctor to perform medical examination.

At 0621 LT, the medical doctor came to the cockpit accompanied by FA3. After examining the PIC, the medical doctor requested supplementary oxygen to the FA3.

At 0626 LT, the TMA controller asked the pilot whether assistance was required upon arrival and was responded by the SIC that they needed 15 minutes of holding. The SIC considered that the aircraft weight should be reduced by burning more fuel during the holding to avoid an overweight landing. Thereafter, the TMA controller instructed the SIC to contact Surabaya Approach controller on frequency 123.2 MHz, as the subsequent approach control services would be provided by Approach (APP) controller.

The FA3 came to the cockpit, delivering portable oxygen bottle along with FA2 who brought Emergency Medical Kit (EMK). The medical doctor and the FA then put an oxygen mask on the PIC.

At 0629 LT, the SIC made initial contact with APP controller and informed them that the aircraft was holding on Waypoint SADPU. The APP controller responded by advising the SIC to report when ready for approach.

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[7] The aircraft operator ground personnel is located in Surabaya provided with a radio to communicate with pilots to coordinate the operational matters.

[8] Waypoint SADPU is located at coordinate 07°25'45.9"S 113°01'49.4"E, about 14 nautical miles from Runway 28.

At 0630 LT, the APP controller instructed the SIC to turn left to heading 360° for traffic separation, and was acknowledged by the SIC. The APP controller then asked the SIC if there were any objections to allowing another aircraft to make landing approach prior to the CTV307. The SIC advised that there was no objection. The APP controller then instructed the SIC to return to Waypoint SADPU and maintain at altitude of 5,000 feet.

At 0632 LT, the aircraft operator ground personnel asked the SIC whether an ambulance would be required upon arrival. The SIC confirmed the request for an ambulance and requested ground support equipment for electrical power and air conditioning, as the Auxiliary Power Unit (APU) of the aircraft was unserviceable.

At 0634 LT, the FA3 made passenger announcement seeking a qualified Airbus A320 pilot on board the aircraft, but there was no qualified pilot on board among the passengers.

At 0635 LT, the SIC informed the APP controller that they were ready for approach. The APP controller approved the landing approach to Runway 28 and instructed the aircraft to descend to altitude of 3,500 feet. The APP controller then canceled the clearance for another aircraft that was making a landing approach, with intention to give the CTV307 priority to land.

About 0637 LT, the medical doctor advised the FA1 and FA2 that the PIC's breath and pulse were no longer detectable. The medical doctor also asked both FAs to lay the PIC on the cockpit floor. After the PIC was laid down on the cockpit floor, resuscitation was given to the PIC by the medical doctor, assisted by the two FAs.

At 0638 LT, the APP controller cleared the CTV307 to descend to altitude of 2,500 feet and to make Required Navigation Performance (RNP) approach to Runway 28.

At 0642 LT, when the aircraft was about 7 Nm from the runway, the APP controller instructed the SIC to contact the TWR controller who then issued a clearance to the aircraft to land on Runway 28.

The SIC configured the aircraft for landing, including extended the landing gear. After hearing the landing gear was being extended, the FA1 went to cabin to conduct landing preparation and asked the FA3 to announce that the aircraft was about to land.

At an altitude of about 2,000 feet, the SIC decided to make a go around considering that landing preparation was insufficient and the medical doctor and the FA2 were still resuscitating the PIC. At 0645 LT, the SIC advised the TWR controller of the go-around and requested to make landing approach using Runway 10. The TWR controller then instructed SIC to climb to altitude of 5,000 feet and fly to Waypoint LOTEK[9].

At 0649 LT, the SIC suggested the medical doctor and the FA2 to return the PIC to his seat as the aircraft was about to land. The FA2, FA3, and the medical doctor returned the PIC to his seat, assisted by the SIC.

At 0650 UTC, the SIC reported to the TWR controller that the aircraft was establishing localizer for Instrument Landing System (ILS) approach to Runway 10 and was instructed to continue the landing approach. About one minute later, the SIC asked the

[9] Waypoint LOTEK is located at coordinate 07°20'22.2"S 112°32'19.4"E, about 14 nautical miles from Runway 10.

FA2 to fasten the PIC's seatbelt and lock the PIC shoulder harness. The FA3 and the doctor returned to the cabin, while FA2 remained in the cockpit and occupied the third pilot seat to make sure the PIC was properly secured. During the occurrence, the SIC always wore seatbelts and harnesses while seated.

At 0656 LT, the aircraft landed on Runway 10 with flap full down configuration and autobrake set to medium selection. The estimated landing weight was 64,700 kilograms. After landing, the SIC stopped for about a minute on the runway near Taxiway N5. The TWR controller confirmed to the SIC whether everything was fine and was affirmed.

Considering that the PIC required immediate medical treatment, the SIC decided to vacate the runway via Taxiway N6 to the Parking Stand 6 at Terminal 1. After the aircraft stopped on Parking Stand 6 and the forward cabin door was opened, the medical personnel of the airport entered the aircraft to examine the PIC condition. The PIC then transported to a hospital. Afterward, the passengers disembarked the aircraft. The PIC was pronounced deceased upon arrival at the hospital, and the time of death was unknown.

No injury was reported in this occurrence, and the aircraft was undamaged.

1.2 Personnel Information

1.2.1 Pilot in Command

The PIC was 48 years Indonesian which had Airline Transport Pilot License (ATPL) and qualified as an Airbus A320 pilot. The last proficiency check of the PIC was conducted on 13 July 2022.

The flying experience of the PIC was as follows:

Last 90 days	:	166 hours 29 minutes
Last 30 days	:	46 hours 30 minutes
Last 7 days	:	17 hours 7 minutes
Last 24 hours	:	5 hours 37 minutes

The PIC underwent medical examination every six months at *Balai Kesehatan Penerbangan* (Aviation Medical Center). The medical examination included the test of fasting blood glucose, kidney function, liver function, lipid profile, uric acid, exercise Electrocardiogram (ECG) using Bruce Protocol[10] and resting ECG. Due to confidentiality reasons, the medical information was not highlighted to the company.

Over the previous five years, the medical examination records indicated that the cholesterol level of the PIC was constantly above the determined normal value by the Aviation Medical Center and the PIC was in overweight condition. The PIC had been recommended medical interventions, including regular exercise and a low-fat diet. Given that the PIC's cholesterol level never went above 320 mg/dL, the PIC did not

[10] Bruce Protocol is a standardized protocol for electrocardiogram-monitored exercise using increasing speeds and elevations of the treadmill; a test for ischemia usually due to coronary artery disease. This definition is based on Farlex Partner Medical Dictionary (2012)

receive a referral for statin therapy[11] from the Aviation Medical Center. The investigation also did not find any information that the PIC was on statin therapy.

The medical examination record also mentioned that the PIC had been an active smoker for 30 years, with average daily consumption was a pack of cigarettes (16 cigarettes) per day. The PIC was also being asked to quit smoking by the Aviation Medical Center in 2021, and until the day of the occurrence the PIC was still smoking.

The resting and exercise ECG history of the PIC in the last five years was as follows:

Date	Components	Results	Remarks
26 April 2018	Resting ECG Exercise ECG	Not performed Negative[12] Stress Test (93% Target Heart Rate (HR), 9.75 Mets)	Physical condition[13]: Average
1 November 2018	Resting ECG Exercise ECG	Sinus Rhythm Not performed	Normal
2 May 2019	Resting ECG Exercise ECG	Not performed Negative Stress Test (100% Target HR, 10.59 Mets)	Physical condition: Good
25 October 2019	Resting ECG Exercise ECG	Sinus Rhythm Not performed	Normal
16 June 2020	Resting ECG Exercise ECG	Not performed Negative Stress Test (100% Target HR, 10.59 Mets)	Physical condition: Good
10 December 2020	Resting ECG Exercise ECG	Sinus Rhythm Not performed	Normal
9 June 2021	Resting ECG Exercise ECG	Not performed Negative Stress Test (92% Target HR, 10.17 Mets)	Physical condition: Average
8 December 2021	Resting ECG Exercise ECG	Sinus Rhythm with inferior ischemia[14] Not performed	
6 June 2022	Resting ECG Exercise ECG	Not performed Negative Stress Test (96% Target HR, 9.33 Mets)	Physical condition: Average

[11] Statin Therapy is first-line treatment for primary prevention of cardiovascular disease in patient with elevated cholesterol level (Arnett DK, et al. (2019). 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines).

[12] Negative indicates no abnormality is detected during the test.

[13] Physical condition describes maximum aerobic capacity of a person on a treadmill test, classified into five levels (poor, fair, average, good, and excellent) and categorized into certain range of age.

[14] Sinus Rhythm with inferior ischemia means a regular heartbeat with decreased blood flow to the basal part of the heart caused by blockage of the coronary artery.

The resting ECG result on 8 December 2021, showed that the PIC had sinus rhythm with an anomaly indication of inferior ischemia. As the previous exercise ECG, which was conducted six months before (16 June 2020), indicated a negative result and no further examination advice from cardiologist, the Aviation Medical Examiner (AME) considered the PIC was fit to fly.

The last medical examination of the PIC was conducted on 6 June 2022 or about one month prior to the incapacitation event. During the last medical examination, the PIC underwent exercise ECG and completed 8 minutes and 30 seconds. The PIC achieved an oxygen uptake equivalent to 10 metabolic equivalents (METs) during the exercise. The completion of the exercise was based on the condition that the maximum heart rate was already reached. On that day, there were 60 applicants who underwent resting ECG examination, and 13 applicants underwent exercise ECG including the PIC.

The PIC's exercise ECG result along with the other 72 results were sent via e-mail by a nurse to the cardiologist to be interpreted. At that time, the cardiologist who was at a different place interpreted the result and identified a Left Bundle Branch Block (LBBB[15]) during the recovery phase of PIC's exercise ECG. The cardiologist advised all the result interpretation to the nurse via phone one by one and recalled marking the PIC exercise result as negative with additional instruction to undergo heart computed tomography (CT) scan. The nurse recalled to never receiving the instruction, and the heart CT scan of the PIC was not performed. The PIC's medical record provided to KNKT indicated that the PIC's exercise ECG result was marked as negative without any instruction to undergo a CT scan.

The other medical examination result during the last medical examination showed that the PIC was in overweight condition, and cholesterol level was higher than the normal level determined by the Aviation Medical Center. With reference that all the examination results met the requirement, including the exercise ECG result was negative, no hypertension and diabetes, the Aviation Medical Examiner (AME) granted the PIC a Class 1 Medical Certificate with limitation to wear corrective lenses for near and distant vision, which was valid until 8 December 2022.

The PIC's relatives advised that the PIC used to do cycling or play badminton during his off duty. The favorite foods of the PIC were meat-based dishes, chicken, and whole eggs, and frequently eating in relatively big portions. The PIC usually had enough sleep, about 10 hours a day. The PIC had no history of being hospitalized due to illness and rarely went to the doctor. The family history of heart disease was unknown.

A day before the occurrence, the PIC and the SIC flew together for three sectors before remained overnight at Juanda. The PIC stopped by at a convenience store to buy some snacks on their way to the hotel. The PIC's activity at the hotel was unknown.

Prior to the flight, the PIC left the hotel about 0440 LT. After arriving at the airport, the PIC underwent a blood pressure check and the result was 120/80 mmHg which was within the normal range. According to the other crewmembers who met the PIC

[15] LBBB is a defect in the conduction system of the heart in which electrical conduction down the left bundle branch is delayed (Hill, M. (2002). Mcgraw hill concise medical dictionary of modern medicine)

on the day of the occurrence stated that the PIC appeared to be normal and showed no sign of any illnesses.

1.2.2 Second in Command

The SIC was 26 years Indonesian which had Commercial Pilot License (CPL) and qualified as Airbus A320 pilot. The SIC also had a valid Class 1 Medical Certificate without any limitation.

The last proficiency checks of the SIC was conducted on 20 April 2022.

The flying experience on type of the SIC was as follows:

Total hours	:	128 hours 26 minutes
Last 90 days	:	86 hours 37 minutes
Last 30 days	:	27 hours 54 minutes
Last 7 days	:	5 hours 37 minutes
Last 24 hours	:	5 hours 37 minutes
This flight	:	54 minutes

The SIC was released to be a qualified SIC in March 2022. The SIC had completed several required trainings. Pilot incapacitation training was conducted during the line training on 25 February 2022 which the result was remarked as good. Pilot incapacitation training was also conducted on Full Flight Simulator (FFS) training 5 and 6 on 16 February 2020. FFS 5 was simulated using Runway 20C of Changi Airport, Singapore, while FFS 6 was simulated using Runway 25R of Soekarno Hatta Airport, Jakarta.

The SIC never been trained for taxi training nor had experience to taxi the Airbus A320-200 aircraft.

1.2.3 Flight Attendants

All four flight attendants were Indonesian and held valid Flight Attendant Certificate (FAC) with an Airbus A320 rating. The flight attendants had valid Class 2 Medical Certificates without any limitation. The flight attendants had completed several trainings, including initial and recurrent First Aid Training and Safety Emergency Procedure Training.

All flight attendants had valid periodic trainings and passed the competency check with satisfactory result without any remarks.

1.3 Aircraft Information

The Airbus A320 registered PK-GLW was manufactured by Airbus, a France aircraft company in 2013 with serial number of 5597.

At the day of the occurrence, the aircraft had a valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R). There was no record and report of aircraft abnormality, except the inoperative APU, prior to the flight.

The aircraft takeoff weight was 66,275 kilograms while the maximum was 77,000 kilograms. The landing weight on the occurrence flight was estimated 64,700 kilograms while the maximum was 64,500 kilograms.

1.4 Meteorological Information

The meteorological report for Surabaya, issued on 21 July 2022, at 0622 LT was hazy, visibility was five kilometers and the wind was calm. The meteorological condition was considered not related to the occurrence.

1.5 Aids to Navigation

Runway 10 of Surabaya has Instrument Landing System (ILS) approach guidance facilities. The ILS was serviceable at the day of the occurrence. The navigation aid was considered not contribute to the occurrence.

1.6 Communications

All communications between air traffic controller and the pilot were recorded by ground based automatic voice recording equipment and Cockpit Voice Recorder (CVR). The CVR also recorded the communication in the cockpit area. The quality of the audio recorded transmissions was good.

The communication was considered not contribute to the occurrence. The detail of the communication will be included in the chapter of the Flight Recorders.

1.7 Aerodrome Information

Airport Name	:	Juanda International Airport Surabaya
Airport Identification	:	WARR
Airport Operator	:	PT. Angkasa Pura I
Coordinate	:	07°22’51” S 112°47’11” E
Elevation	:	11 feet
Runway Direction	:	10/28
Runway Length	:	3,000 meters
Runway Width	:	45 meters
Surface	:	Asphalt

The health service available at the airport was a clinic provided by the port health office. There were few hospitals nearby the airport. The closest hospital was approximately nine kilometers, or about 15-minute drive.

1.8 Flight Recorders

The aircraft was fitted with Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR). Both recorders were transported to the KNKT recorder facility for data download process.

The Flight Data Recorder (FDR) manufactured by Honeywell with part number 980-4750-002 and serial number 06017. The Cockpit Voice Recorder (CVR) manufactured by Honeywell with part number 980-6022-001 and serial number 15679. The FDR and CVR data were successfully downloaded.

The FDR recorded 26 hours of aircraft operation with total of 12 flights. The CVR recorded 120 minutes of audio duration for 2 channels including 30 minutes of audio duration for 4 channels.

The FDR information was as follow:

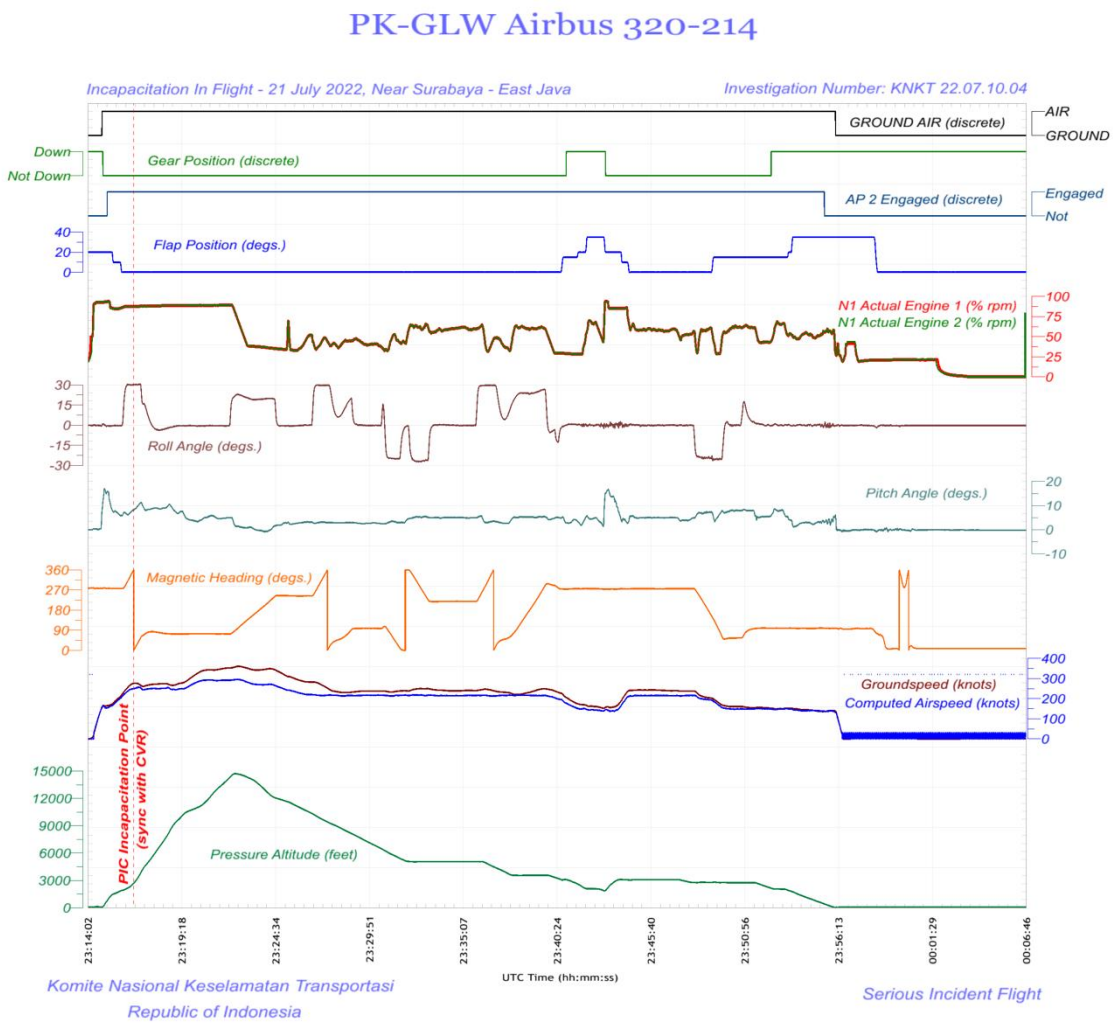


Figure 1 The significant FDR parameters of flight instrument of the serious incident flight

The FDR labelled in UTC time and the local time was UTC +7. The FDR data showed that:

1. At 06:14:18 LT, the take-off was initiated, indicated by the increasing of the N1 of the engines and at 06:14:50 LT the aircraft airborne.
2. At 06:15:08 LT, the autopilot engaged when the altitude was 790 feet.
3. At 0622 LT, the aircraft was at altitude of about 14,700 feet and afterward started to descend.
4. At 0640 LT, the flap extended followed by landing gear extension.
5. At 0643 LT, the aircraft was flying on heading approximately 280 and made go around initiated at an altitude of about 2,000 feet. Subsequently, the landing gear and flaps were retracted.

6. At 0650 LT the aircraft flying on a heading of about 010 and the flap and landing gear extended.
7. At 0656 LT, the aircraft touchdown on Runway 10 and stopped on the runway.
8. At 0658 LT, the groundspeed recorded 19 knots, and the heading changed indicated that the aircraft was taxiing.

The CVR recorded conversation in the cockpit and the communication between pilot and controllers. The events and the excerpt of the CVR data were as follows:

Time (LT)	Event
06:14:18	Sound of engine power increasing, indicated aircraft initiation of takeoff.
06:15:20	The pilots performed after takeoff checklist.
06:15:41	The TMA controller identified the aircraft on departure and instructed CTV 307 pilot to fly directing Waypoint PEDSO.
06:15:48	The PIC requested the TMA controller to repeat the name of the waypoint. The TMA then repeated it and the PIC readback the name of the waypoint.
06:15:57	The PIC relayed the instruction to fly directing Waypoint PEDSO to the SIC.
06:16:29	A sound of system chime.
06:16:37	The SIC called the PIC several times but no response.
06:17:08	A sound like PIC was snoring.
06:17:44	The SIC asked the FA1 to come to the cockpit.
06:19:52	The SIC contacted aircraft operator ground personnel and messaged PAN PAN, and informed that the PIC incapacitated.
06:20:59	The SIC contacted the TMA controller and declared urgency message PAN PAN, due to pilot incapacitation and intended to return to Juanda. The controller advised to descent to 3,500 feet and to proceed to Waypoint SADPU.
06:21:15	FA announced to seek whether any doctor or paramedic onboard.
06:21:59	A medical doctor entered the cockpit and examined the PIC.
06:23:12	The medical doctor asked for a flashlight.
06:25:10	The medical doctor advised that the PIC might have heart attack or stroke. The FA then told the medical doctor that the flight would be returned. The medical doctor agreed with the decision to return and advised that the PIC need to be administered with supplementary oxygen.
06:26:07	The TMA controller confirmed whether any assistance was required on arrival. The SIC replied that would require about 15 minutes for

Time (LT)	Event
	holding.
06:26:08	The medical doctor asked for supplementary oxygen.
06:28:11	Sound similar with oxygen administration.
06:29:36	The medical doctor stated that the blood pressure of the PIC was unable to be measured, and the pulse was very weak.
06:32:18	The aircraft operator ground personnel asked whether ambulance would be required on arrival, and the SIC agreed for ambulance and full ground support as APU was inoperative.
06:34:53	The FA announced to seek whether any Airbus A320 pilot onboard.
06:37:40	The medical doctor instructed the FA to lay down the PIC on the cockpit floor.
06:40:57	The sound of landing gear being extended.
06:42:00	The TWR controller issued landing clearance on runway 28.
06:43:11	The SIC informed made a go around to the controller and was acknowledged by the TWR controller.
06:44:58	The SIC contacted the APP controller that was holding over Waypoint LOTEK and requested for Instrument Landing System (ILS) approach Runway 10 and was acknowledged and approved by the controller.
06:47:56	The medical doctor stated that it was time to stop the resuscitation.
06:49:41	The SIC advised the medical doctor and the FA to return the PIC to his seat and fastened the seat belt as they were about to land. The FA2 remained in the cockpit.
06:53:31	The SIC contacted the TWR Controller and was given landing clearance to Runway 10.
06:56:05	The sound of the aircraft touchdown.
06:56:23	The TWR controller confirmed whether the SIC was able to taxi to apron.
06:56:58	The SIC advised to the TWR controller that was taxiing to apron.
07:02:04	The SIC commanded FAs to disarm slide bar and thereafter commanded to open the passenger door.
07:05:37	Sound like the process of evacuation of the PIC.

1.9 Medical and Pathological Information

The PIC was brought to the nearest hospital and received by the emergency unit personnel. The doctor examined the PIC and declared that the PIC had passed away upon arrival at the hospital. The time of death of the PIC was unable to be determined as the postmortem external examination was not performed.

1.10 Survival Aspects

About 0616 UTC, a minute after the aircraft was airborne, the SIC noticed that the PIC was in rigid posture. Thereafter, the SIC called and tapped the PIC's right thigh and shoulder, however there was no response.

At 0617 LT, the SIC asked the FA via interphone to come into the cockpit and advised that the PIC was incapacitated. The FA1 found the PIC was unconscious, with both eyes closed and hands on the thighs. The FA1 slid the PIC's seat backward and reclined the seat, then released the shoulder harness and loosened the tie. The FA1 assumed the PIC was faint as she was able to see the PIC's chest movement. Therefore, the FA1 did not administer oxygen to the PIC. The FA1 went back to the cabin to inform the FA3 that the PIC incapacitated and asked her to seek medical personnel among passengers. The FA1 then came back into the cockpit and brought aromatherapy oil to rouse the PIC. The attempt of the FA1 to wake up the PIC using the aromatherapy oil was not successful.

At 0621 LT, the FA3 announced whether any doctor or paramedic onboard. A passenger claimed to be a medical doctor and acknowledged by the FA3 without verifying the identification of the passenger who claimed to be a doctor. A few moments later, the medical doctor entered the cockpit accompanied by FA3. There were also two other passengers who claimed to be medical doctors who then advised by the FA that a doctor was already in the cockpit.

The medical doctor examined the PIC and detected spontaneous breathing with weak pulse, the Glasgow Coma Scale (GCS)[16] of the PIC was 3 (E1M1V1) which means there were no responses in eye opening, motor response and verbal response, and there was no sign of stomach problem, respiratory problem, brain injury or neurological deficit such as anisocoria[17] or lateralization of the pupils. The medical doctor then advised the FA and SIC that the PIC might have heart attack or stroke.

At 0626 LT, the medical doctor asked for supplementary oxygen, and the FA3 went to the cabin to get portable oxygen bottle as the FA was not familiar to use the quick donning oxygen mask in the cockpit. About two minutes later the FA3 delivered portable oxygen bottle to the medical doctor along with the EMK brought by FA2. The doctor put an airway tube on the PIC, then FA1 put on the oxygen mask, and the doctor set the oxygen flow to 4 liters per minute.

At 0629 LT, the medical doctor stated that the blood pressure of the PIC was unable to be measured, and the pulse was very weak.

About 0637 LT, the medical doctor advised the FAs that the PIC breathing and pulse was no longer detected, and the light reflex of both pupils were negative. The medical doctor then asked the FA to lay down the PIC on the cockpit floor and not to be brought out of cockpit in order not to be seen by the other passengers. The medical doctor prepared for cardiopulmonary resuscitation (CPR) by positioning the PIC on the floor with legs raised up at the reclined seat. The medical doctor checked the airway was

[16] The Glasgow coma scale (GCS) is a tool used to assess and calculate a patient's level of consciousness. The details explanation of GCS can be found in Glasgow Coma Scale Explained BMJ (Mehta R and Chinthapalli K, 2019) in the following link https://doi.org/10.1136/bmj.l1296

[17] Anisicoria is condition in which the pupils of the eyes are not of equal size. This definition is based on Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health, Seventh Edition (2003).

clear, no smell of alcohol, and no airway obstruction. The medical doctor then started to conduct chest compression without mouth-to-mouth breathing due to the situation of Covid-19 pandemic. During the resuscitation, the medical doctor was assisted by FA1 and FA2.

After receiving the report of pilot incapacitation event, the air traffic services officer contacted the Airport Rescue and Fire Fighting (ARFF) personnel to inform of pilot incapacitation. About 0640 LT, an airport aviation security officer came to policlinic of the Port Health Office of Surabaya to inform an incapacitated pilot of a flight, and the aircraft was approaching to land. About one minute later, the aircraft operator ground personnel also called the Port Health Office personnel requesting medical assistance.

About 0642 LT, the FA1 left the cockpit after hearing landing gear being extended. The FA1 went back to the cabin for landing preparation. The medical doctor and FA2 continued resuscitating the PIC. The SIC made go around and the doctor and FA2 remained in the cockpit continued resuscitating.

About 0645 LT, the medical team of Port Health Office arrived at the apron.

At 0649 LT, the SIC informed that the aircraft was about to land and suggested the medical doctor and the FA2 to return the PIC to his seat. The medical doctor stopped the resuscitation and assisted by the FA2, FA3 and SIC putting back the PIC to his seat, fastened the seatbelt and locked the shoulder harness.

The FA3 and the medical doctor returned to the cabin, while FA2 remained in the cockpit occupied the third pilot seat to guard the PIC.

At 0656 LT, the aircraft landed on Runway 10, considering that the PIC required immediate assistance, the SIC decided to continue the taxi vacating the runway via Taxiway N6 then parked on Parking Stand 6 of the Terminal 1.

At 0710 LT, after the aircraft stopped and the forward cabin door was opened, the medical personnel of the airport entered the aircraft to examine the PIC condition. The medical team found the PIC unconscious on seating position with airway tube put on. The examination result was no pulse and oxygen saturation detected, pupils were mydriasis[18], and the skin looked cyanotic[19].

The medical team asked the aircraft operator ground personnel to help evacuating the PIC to the ambulance using scoop stretcher.

At 0716 LT, the medical team brought the PIC using ambulance to a hospital which was located approximately 10 kilometers away for further treatment. About 15 minutes later, the ambulance arrived at the hospital and received by the emergency unit personnel.

[18] Mydriasis is dilation of the pupil of the eye, especially when excessive or prolonged, usually as a result of trauma, a medical disorder, or a drug. This definition is based on This definition is based on Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health, Seventh Edition (2003).

[19] Cyanotic is marked by bluish discoloration of the skin due to a lack of oxygen in the blood. It is one of the types of congenital heart disease. This definition is based on Farlex Partner Medical Dictionary (2012).

1.11 Organizational and Management Information

1.11.1 Aircraft Operator

Aircraft Owner : Alafco Irish Aircraft Leasing Eleven Limited

Aircraft Operator : PT Citilink Indonesia

Address : Komplek Juanda Bisnis Center (JBC) Blok C1 No.2 Jl. Raya Juanda Desa Sawotratap Kecamatan Gedangan Kabupaten Sidoarjo, Jawa Timur, Indonesia

AOC Number : AOC 121-04

The company had not developed a health monitoring system for maintaining the health of crewmember. The crewmember underwent medical examination regularly at Aviation Medical Center.

1.11.1.1 Pilot Incapacitation Guidance Materials for Fit Pilot

Citilink Operation Manual Part B1: Standard Operating Procedures and Aircraft Information (OM-B1) subchapter 1.4.17 states procedures to handle the crew incapacitation was described in Citilink Operation Manual Part A: General (OM-A) chapter 15 and Citilink Airbus A320 Flight Crew Techniques Manual (FCTM) subchapter PR-AEP-MISC.

The OM-A subchapter 15.1 defines crewmember incapacitation as:

> *Crewmember incapacitation is defined as any condition which affects the health of crewmember during the performance of duties associated with the duty assigned to him/her which renders him/her incapable of performing assigned duties, either total or partial incapacitation which does not allow the fulfillment of duties in normal way.*

The OM-A subchapter 15.2 describes type of incapacitation as follows:

1. *Obvious incapacitation;*

   Means total functional failure and loss of capabilities. In general will be easily detectable and of prolonged occurrence. Among possible causes are heart disorders severe brain disorders, internal bleeding, food poisoning, etc.

2. *Subtle incapacitation;*

   Is a more significant operational hazard, because it is difficult to detect and the effect can range from partial loss of function to complete unconsciousness. Among the possible causes might be minor brain seizures, hypoglycemia (low blood sugar), other various medical disorders, extreme fatigue or pre-occupation with personal problems. Because a flight crewmember may not be aware of, or capable of rationally evaluating his/her situation, this type of incapacitation is the more dangerous.

Incapacitation may range from minor cases of physiological upsets associated with inter-current mild disease or mental stress which may result in reduced levels of judgment or physical coordination up to a complete collapse.

Things that can cause mild incapacitation:

- *Body pain such as toothache, headache, gastroenteritis, delayed effects of alcohol, drug or medications, common disorder (i.e. cold).*
- *Heart trouble, an acute infection thrombosis, epilepsy, hypo-glycerin (extremely low level sugar) and others belong to the more serious causes of a sudden collapse.*

The OM-A subchapter 15.3 highlights the keys to early recognition of incapacitation as follows:

Early recognition of incapacity is very important. A silent collapse shall hardly be detected during normal cruise phase, as communications may sometimes decline to minimum. This requires that all crewmembers monitor each other very closely.

"Closely" means observing other crewmember for any "abnormal" reaction, action and/or behavior. One good method is to use the term "two communication rule", meaning that one crewmember's comment must be answered by the other.

…

Other symptoms of the beginning of an incapacitation are:

- *Incoherent speech;*
- *Strange behavior;*
- *Irregular breathing;*
- *Pale fixed facial expression;*
- *Jerky motions that are either delayed or to rapid.*

If any of these are present, incapacitation must be suspected and action taken to check the state of a crewmember.

The OM-A subchapter 15.4 describes actions to be taken when pilot incapacitation was detected as follows:

The recovery from a detected incapacitation of the fit pilot shall follow the sequence below:

First Phase

1. *Assure a safe condition of flight*
2. *Take over the controls immediately.*
3. *Ensure that autopilot is engaged.*
4. *Declare an emergency to ATC*
5. *Call Flight Attendant via PA : "FA-1 REPORT TO COCKPIT"*
6. *Take whatever steps are possible to ensure the incapacitated pilot cannot interfere with the handling of the aircraft. This may include involving flight attendant to restrain the incapacitated pilot:*
    a) *Pull pilot seatback by shoulders, if possible recline seat.*
    b) *Fasten shoulder harness, secure pilot arms inside harness.*
    c) *Lock shoulder harness by moving the locking lever.*
    d) *Bring seat away from the control and around to ward the side window until seat clicks into locked position.*
    e) *Take pilot seat off pedals.*
    f) *Be prepared to administer oxygen (quick donning oxygen system), if needed.*
    g) *Be ready for flight crew orders.*
7. *Request assistance from any medically qualified passenger and take necessary step(s) to help the incapacitated flight crew.*
8. *Check if a type qualified pilot is onboard to replace the incapacitated crewmember. If no type qualified pilot is available, 1 (one) Flight Attendant other than Flight Attendant-1 (FA-1), should remain in the cockpit.*

    Note: FA-1 shall brief other flight attendant to ensure that all exits are covered (in certain case, 1 flight attendant will have to handle 2 doors) and give their new assignment (applicable for A330 & A320).
9. *Land at the nearest suitable airport after considering all pertinent factors.*
10. *Request medical assistance after landing giving many details about the condition of the affected crewmember.*
11. *The remain cockpit crew shall wear seatbelts and harnesses at all times.*

Second Phase

1. *Prepare the approach preparation earlier.*
2. *Request radar vectoring and prefer a long approach to reduce workload if possible.*
3. *Perform the landing from the fit pilot usual seat.*

The FCTM subchapter PR-AEP-MISC describes flight crew incapacitation procedures as follows:

GENERAL

Flight crew incapacitation is a real safety hazard that occurs more frequently than many of the other emergencies. Incapacitation can occur in many forms, that range from sudden death to partial loss of function. Sometimes the flight crew does not have any symptom before incapacitation.

DETECTION

In order to help with the early detection of flight crew incapacitation, the Crew Resource Management (CRM) principles should be applied:

- *Correct crew coordination that involves routine monitoring and aural crosschecks. The absence of standard callouts at the appropriate time may indicate incapacitation of one flight crewmember*
- *If one flight crewmember does not feel well, the flight crew must inform the other flight crewmember.*

Other symptoms, for example incoherent speech, a pale and(or) fixed facial expression, or irregular breathing, may indicate the beginning of incapacitation.

ACTION

In the case of flight crew incapacitation, the fit flight crewmember should apply the following actions:

- *Take over and ensure a safe flight path:*
  - *Announce "I have control"*
  - *If the incapacitated flight crewmember causes interference with the handling of the aircraft, press the sidestick pb for 40 seconds*

|*L2*| [20] *The time required of 40 s includes the time necessary for AP deactivation (if AP engaged) and the time for offside sidestick deactivation.*

|*L1*| [21]
  - *Keep or engage the onside AP, as required*
  - *Perform callouts (challenge and response included) and checklists aloud.*

- *Inform the ATC of the emergency*
- *Take any steps possible to contain the incapacitated flight crewmember. These steps may involve cabin attendants*
- *In order to reduce the workload, consider:*
  - *Early approach preparation and checklists reading*
  - *Automatic Landing*

---

[20] L2 means Layer 2 “Nice to know” which presents information that is used as a reference, in order to fully understand the logic of the aircraft and pilot interfaces

[21] L1 means Layer 1 “Need to know” which presents information that is necessary in the cockpit.

- *Use of radar vectoring and long approach.*

- *Land at the nearest suitable airport after consideration of all pertinent factors*
- *Arrange medical assistance onboard and after landing, providing as many details as possible about the condition of the affected flight crewmember*
- *Request assistance from any medically qualified passenger, except for flight with only two flight crewmembers onboard (i.e. freighter or ferry flight).*

Citilink Operation Manual Part D1: Pilot Training (OM-D1) subchapter 4.2.1.5.6, uses an outdated Citilink Airbus A320 Flight Crew Operating Manual (FCOM) subchapter PRO-ABN-80 as reference document to conduct pilot incapacitation exercise in Full Flight Simulator training. The mentioned FCOM describes Crew Incapacitation procedure as memory item which requires fit pilot to call FA using PA, ensure the incapacitated pilot to be restrained, request assistance from any medically qualified passenger and to check if a type of qualified company pilot is on board to replace the incapacitated pilot.

The note from cockpit preparation for Airbus type aircraft describes in the OM-B1 subchapter 2.5.1.2.1 states:

CM2[22] is not allowed to perform the taxi. In case of Pilot Incapacitation and/or Left Hand Side Nose Wheel Steering Fault, after completion of the related procedures and the problem still exist, CM2 may taxi the aircraft to vacate the runway to safe area and shall request assistance to tow the aircraft.

For A330-900 CM2 is allowed to perform the taxi out and taxi in except for docking process (before turning to the gate/ Docking area).

1.11.1.2 Pilot Incapacitation Guidance Materials for Flight Attendant

Citilink Operation Manual Part B2: Flight Attendant Procedures (OM-B2) contains guidance and procedures related to pilot incapacitation. The types of incapacitations, causes and effects and recognition description are mentioned in the OM-B2 have same content as the OM-A.

The OM-B2 subchapter 10.8.5 describes FA duties during pilot incapacitation as follows:

PIC will call flight attendant via PA: "FA-1 REPORT TO COCKPIT"

Flight Attendant duties:

1. *Take whatever steps are possible to ensure the incapacitated pilot cannot interfere with the handling of the aircraft:*
   a. *Pull pilot seatback by shoulder, if possible recline seat.*
   b. *Fasten shoulder harness, secure pilot arms inside harness.*
   c. *Lock shoulder harness by moving the lock lever.*
   d. *Bring seat away from the control and around toward the side window until seat clicks into locked position.*
   e. *Take pilot seat off pedals'*

[22] CM2 is pilot who seated on the right seat.

f. Be prepared to administer oxygen (quick donning oxygen mask), if needed.

g. Be ready for flight crew orders.

2. Request assistance from any medically qualified passenger and take necessary step(s) to help the incapacitated flight crew.

3. Check if a type qualified pilot is onboard to replace the incapacitated crew member. If no type qualified pilot available, 1 (one) flight attendant other than FA-1 should remain in the cockpit (A330 & A320).

Note: FA-1 shall brief other flight attendants to ensure that all exits are covered (in certain case, 1 flight attendant will have to handle 2 doors) and give their new assignment.

The investigation was unable to find detailed information in the aircraft operator documents related to the task of the remaining FA in the cockpit when no type qualified pilot is available.

1.11.1.3 Crewmember Training

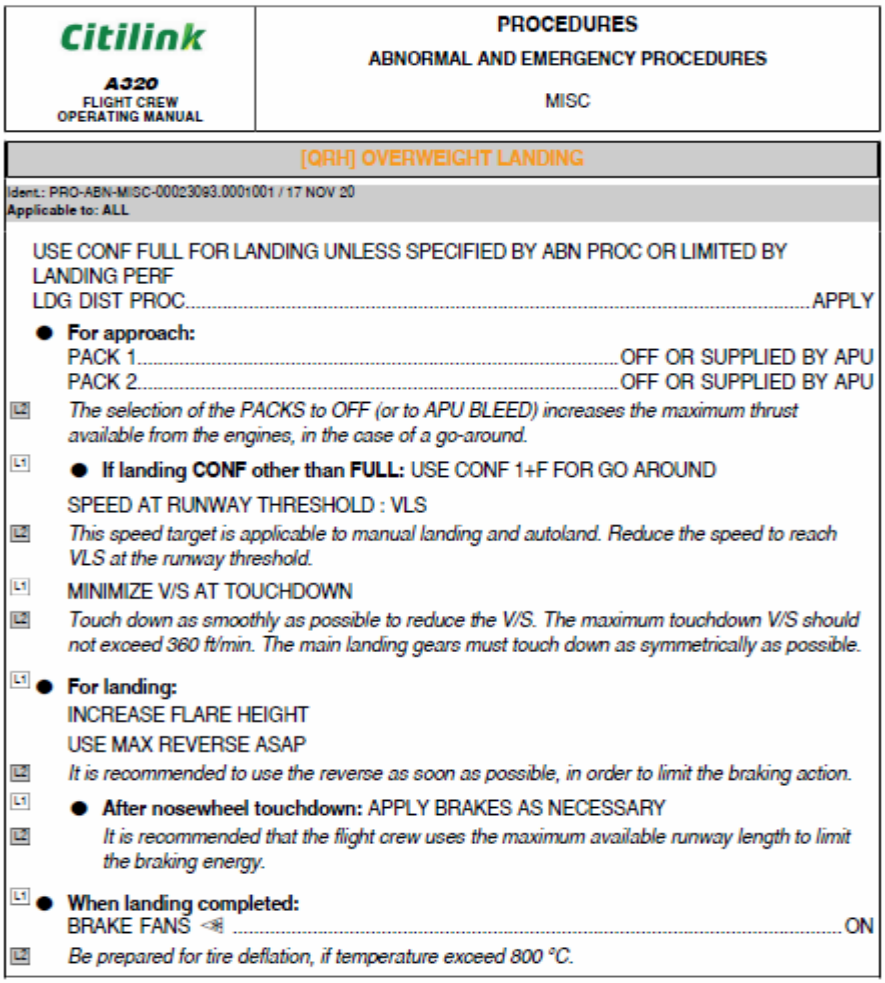
According to the OM-D1 subchapter 4.1.1.5.2, the pilot training to handle pilot incapacitation event was categorized as specialized training which required check or evaluation and must be conducted on ground and simulator training. Those ground and simulator training of pilot incapacitation exercise required to be conducted every 36 months.

The OM-D1 subchapter 4.2.1.5 describes the Type Qualification A320 Training must include Full Flight Simulator (FFS) training with incapacitation exercise. The crew incapacitation event must be exercised once in FFS5, and the result will be reviewed in FFS6. According to the OM-D subchapter 4.2.1.5.6, the reference document to conduct pilot incapacitation exercise in FFS5 training was the FCTM subchapter PR-AEP-MISC page 10/32 and an outdated Flight Crew Operating Manual (FCOM) subchapter PRO-ABN-80. The pilot incapacitation training subject in the line training also used the same reference of FCTM and FCOM with additional document of OM-A.

Citilink Operation Manual Part D2: Flight Attendant Training (OM-D2) subchapter 5.3.1.6 described that training to handle crew incapacitation was included in the Safety Emergency Procedure Training and the training to administer oxygen was included in the First Aid Training. However, the exercise to administer oxygen in both training utilized portable oxygen, and the use of quick donning oxygen mask was only showed in a video presentation.

1.11.1.4 Weight Limitation and Overweight Landing Procedure

According to FCOM, maximum landing weight for PK-GLW aircraft is 64,500 kg. An immediate landing at weight above maximum landing is permitted in exceptional cases (in flight turn back or diversion), provided the pilot follows the overweight landing procedure.



Citilink
A320
FLIGHT CREW OPERATING MANUAL

PROCEDURES
ABNORMAL AND EMERGENCY PROCEDURES
MISC

[QRH] OVERWEIGHT LANDING

Ident.: PRO-ABN-MISC-00023093.0001001 / 17 NOV 20
Applicable to: ALL

USE CONF FULL FOR LANDING UNLESS SPECIFIED BY ABN PROC OR LIMITED BY LANDING PERF
LDG DIST PROC.....APPLY

● **For approach:**
PACK 1.....OFF OR SUPPLIED BY APU
PACK 2.....OFF OR SUPPLIED BY APU

L2 *The selection of the PACKS to OFF (or to APU BLEED) increases the maximum thrust available from the engines, in the case of a go-around.*

L1 ● **If landing CONF other than FULL:** USE CONF 1+F FOR GO AROUND

SPEED AT RUNWAY THRESHOLD : VLS

L2 *This speed target is applicable to manual landing and autoland. Reduce the speed to reach VLS at the runway threshold.*

L1 MINIMIZE V/S AT TOUCHDOWN

L2 *Touch down as smoothly as possible to reduce the V/S. The maximum touchdown V/S should not exceed 360 ft/min. The main landing gears must touch down as symmetrically as possible.*

L1 ● **For landing:**
INCREASE FLARE HEIGHT
USE MAX REVERSE ASAP

L2 *It is recommended to use the reverse as soon as possible, in order to limit the braking action.*

L1 ● **After nosewheel touchdown:** APPLY BRAKES AS NECESSARY

L2 *It is recommended that the flight crew uses the maximum available runway length to limit the braking energy.*

L1 ● **When landing completed:**
BRAKE FANS .....ON

L2 *Be prepared for tire deflation, if temperature exceed 800 °C.*

1.11.1.5 Landing Checklist

The FCTM described landing checklist as follows:

Checklist trigger: LDG CONF set and cabin report received.

ECAM MEMO.....LDG NO BLUE

- LDG GEAR DN

- SIGNS ON

- CABIN READY

- SPLRS ARM

- FLAPS FULL or CONF 3

The PF checks no blue items on the ECAM memo.

The PF announces "LANDING NO BLUE".

CABIN..... READY

The PF confirms that the cabin report is received. The PF announces "READY".

1.11.2 DGCA Pilot Medical Standard and Certification

The medical standard and certification for pilot was regulated in the Civil Aviation Safety Regulation (CASR) Part 67. The subpart 67.21 of the CASR Part 67 required pilot who held Airline Transport Pilot License (ATPL) to have Class 1 Medical Certificate issued by Directorate General of Civil Aviation (DGCA).

The CASR Part 67 subpart 67.101 described that prior to the issuance of the medical certificate, an applicant must undergo a medical assessment to determine that the applicant is physically and mentally fit to perform his duty. One of the considerations of physical requirements for Class 1 Medical Certificate were described in the CASR Part 67 subpart 67.203 as follow:

...

6. *The applicant shall not possess any abnormality of the heart, congenital or acquired, which is likely to interfere with the safe exercise of the applicant's license and rating privileges. A history of proven myocardial infarction shall be disqualifying.*

...

One of the methods to determine abnormality of the heart or abnormal cardiac rhythm is using Electrocardiogram (ECG) examination. The CASR Part 67 subpart 67.203 required an applicant of Class 1 Medical Certificate to undergo resting Electrocardiogram (ECG) examination for the first issue of the medical certificate. An applicant with age above 40 years, the resting ECG must be reexamined at the first six months and followed with exercise ECG (Treadmill Stress Test/TMT) at the next six month or vice versa. The detailed procedures to conduct ECG was described in the Staff Instruction (SI) 67-02.

The SI 67-02 subchapter I.2 described that resting ECG is an insensitive tool for the detection of presymptomatic coronary artery disease. In addition, sensitivity of the exercise ECG is only 60 to 70%. When resting ECG indicated minor anomaly, a further and fuller review should be carried out to clarify the anomaly, for example using exercise ECG.

The SI 67-02 subchapter I.2 also described the exercise ECG as follow:

...

c. *The subject should be exercised to symptom limitation and be expected to complete at least three stages — nine minutes — of the protocol or achieve an oxygen uptake equivalent to 11 metabolic equivalents (METs). The age-predicted maximum heart rate is calculated by subtracting the age in years from 220 (beats/minute (bpm)). The test is most sensitive when taken to symptom limitation rather than any percentage of the age-predicted maximum. The reason for discontinuing the test should be recorded, together with the presence or absence of any symptoms.*

...

The SI 67-02 subchapter I.3 defined vascular risk factors as follow:

> *Vascular risk factors are those inherited or acquired (often metabolic) abnormalities, or lifestyle patterns, which are associated with an increased risk of coronary (and cerebro-vascular) events. They include hypertension, hyperlipidemia, diabetes, smoking, obesity and lack of exercise.*

In terms of hyperlipidemia (high cholesterol level), Aviation Medical Center determined normal value of cholesterol level between 0 up to 200 mg/dL. The SI 67-02 subchapter I.3 described that a total cholesterol level more than 320 mg/dL should be treated regardless the presence of any risk factors, and the treatment was recommended to use a statin.

The SI 67-02 subchapter I.4 described intervention against vascular risk factors is associated with a significant reduction in fatal and non-fatal cardiovascular events. The intervention should be conducted before declared disease or after a cardiovascular event, especially if there are multiple risk factors present.

1.11.3 Resting Electrocardiogram and Exercise Electrocardiogram Process

Resting ECG and exercise ECG were conducted in Cardiology Polyclinic at Aviation Medical Center. A medical record officer assisted the applicants for registration, including brief anamnesis about medical history, physical activities, and treatment history. After completing the registration, the test would be conducted by a nurse. The test results were sent via e-mail to the cardiologist to be interpreted. The cardiologist examined the test results at different place and was present once a week at Aviation Medical Center. After examining all the test results, the cardiologist contacted the nurse by phone to inform all the results. Those results were inputted into the database by the nurse.

1.12 Additional Information

1.12.1 Heart Attack

According to the Centers for Disease Control and Prevention (CDC)[23], a heart attack happens when a part of the heart muscle does not get sufficient blood. The major symptoms of a heart attack are as follows:

- chest pain or discomfort;
- feeling weak, light-headed, or faint;
- pain or discomfort in the jaw, neck, or back;
- pain or discomfort in one or both arms or shoulders;
- shortness of breath.

The CDC described risk factors of heart attacks including high blood pressure, high blood cholesterol levels, diabetes, and obesity. Those risks are increased by individual lifestyles such as eating a diet high in saturated fats, trans fat, and cholesterol, not getting enough physical activity, drinking too much alcohol, and smoking.

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[23] Centers for Disease Control and Prevention (CDC) is the national public health agency of the United States of America. The detail article of the hearth attack can be found in the following link https://www.cdc.gov/heartdisease/heart_attack.htm

According to American Heart Association[24], a cardiac arrest can occur as a complication of a heart attack. Cardiac arrest is the condition when the heart suddenly stops beating. A cardiac arrest victim loses consciousness within seconds, lies pulseless but may continue to have abnormal breathing for several minutes, which can confuse laypersons into thinking that the individual has just fainted.

1.12.2 Dyslipidemia and Cardiovascular Disease

According to the Hedayatnia et al. (2020)[25], Dyslipidemia may be defined as increased levels of serum total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), or decreased serum high-density lipoprotein cholesterol (HDL-C) concentration.

The research also states cardiovascular disease (CVD) is a chronic non-communicable disease and one of the most important causes of death and disability. Dyslipidemia and lipid oxidation are thought to be important determinants of atherosclerosis that leads to CVD. Wallace et al. and Wilson et al. have demonstrated a direct relationship between serum LDL-C and CVD incidence. It has also been shown that an increased level of TC (hypercholesterolemia), particularly LDL-C promotes the atherosclerosis process, leading to the deposition of cholesterol and fatty acids in the artery wall, whilst HDL-C is usually considered to be protective and returns cholesterol to the liver. However, some studies have reported that high or normal levels of HDL-C are not protective against CVD events. A single serum HDL-C level reflects the HDL-C pool rather than its functionality. Modified forms of the various protein components of HDL, perhaps generated by oxidative stress, may reduce the ability of HDL to take part in reverse transport.

According to the Marshall et al. (2010)[26], exercise ability is a predictor of cardiovascular disease risk. The ability to complete the 9-minute Bruce protocol on an exercise ECG is linked to a very low risk of cardiovascular disease.

1.13 Useful or Effective Investigation Techniques

The investigation was conducted in accordance with the KNKT approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

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[24] American Heart Association is a nonprofit organization in the United States that funds cardiovascular medical research, educates consumers on healthy living and fosters appropriate cardiac care in an effort to reduce disability and deaths caused by cardiovascular disease and stroke. The detail article can be found on the following link https://www.ahajournals.org/doi/full/10.1161/CIRCULATIONAHA.113.006126

[25] Hedayatnia et al. (2020). Dyslipidemia and Cardiovascular Disease Risk Among the MASHAD Study Population. The full article can be found in the following link https://link.springer.com/article/10.1186/s12944-020-01204-y

[26] Marshall et al. (2010). Prognostic Value of a Nine-Minute Treadmill Test in Patients Undergoing Myocardial Perfusion Scintigraphy. The full article can be found in the following link https://www.sciencedirect.com/science/article/abs/pii/S0002914910014086

2 ANALYSIS

The investigation did not find any issue related to aircraft system malfunction, therefore, the analysis will discuss about the medical aspect and medical examination of the pilot, action of the fit pilot, handling of pilot incapacitation, and procedures for pilot incapacitation.

2.1 Pilot Medical Aspect

The Pilot in Command (PIC) underwent a medical examination every six months at *Balai Kesehatan Penerbangan* (Aviation Medical Center). Those medical examinations were performed in accordance with the Directorate General of Civil Aviation (DGCA) Staff Instruction (SI) 67-02 to ensure that the applicant meet the medical standard described in the Civil Aviation Safety Regulation (CASR) Part 67.

The medical examination records of the PIC in the last five years showed that the cholesterol level constantly exceeded the normal value determined by the Aviation Medical Center. The PIC was overweight and an active smoker. The exercise Electrocardiographic (ECG) results in 2020 and 2021 showed that the physical condition degraded from good to average condition and remained unchanged during the last exercise ECG in 2022.

The DGCA's Staff Instruction (SI) 67-02 subchapter I.3 described high cholesterol level, smoking, and obesity was included as vascular risk factors which can increase risk of coronary events such as heart attack. Neither the CASR Part 67 nor SI 67-02 required pilots with vascular risk factors to be assessed as unfit during medical examination. However, the SI 67-02 subchapter I.4 described that the vascular risk factors should be intervened even before the declared disease, especially if there are multiple risk factors present. In addition, the SI 67-02 also described that cholesterol level above 320 mg/dL should undergo statin therapy.

Over the past five years, considering the result of the medical examination, the PIC received intervention recommendations from the Aviation Medical Center to conduct low fat diet and routine exercise on every medical examination. In 2021, the PIC was asked to quit smoking. The investigation did not find any referral for a statin therapy to reduce the high cholesterol level nor any information that the PIC was on statin therapy. In the last medical examination, which was performed about a month prior to the occurrence, the vascular risk factors remained. This condition indicated that the intervention to eliminate the vascular risk factors did not success.

During recovery phase of exercise ECG in the last medical examination, a Left Bundle Branch Block (LBBB) was identified, indicating a defect in the conduction system of the heart.

The medical examination on the PIC which was conducted by a medical doctor during the occurrence flight found that the PIC was pulseless followed by no breathing. There was no sign of stomach illness, respiratory problem, or neurological problem. The medical doctor suspected the PIC had a heart attack or stroke. Considering that the PIC had several vascular risk factors, the incapacitation was likely due to heart attack. The possibility of cardiovascular events resulting from inadequate intervention measures to remove vascular risk factors might have rendered the PIC's incapacitation.

2.2 Pilot Medical Examination

CASR Part 67 subpart 67.21 requires pilot holding an Airline Transport Pilot License (ATPL) to have a Class I Medical Certificate which is valid for six months. Prior to the issuance of the medical certificate, a pilot must undergo a medical assessment to determine that the pilot is physically and mentally fit to perform his duty. In accordance with the CASR Part 67 subpart 67.201, any abnormality of the heart or abnormal cardiac rhythm must be assessed as unfit.

One method to determine abnormality of the heart or abnormal cardiac rhythm is using ECG examination. According to the CASR Part 67 subpart 67.203, an applicant above 40 years, the resting ECG must be reexamined at the first six months and followed with exercise ECG (Treadmill Stress Test/TMT) at the next six months, or vice versa.

SI 67-02 subchapter I.2 states that a resting ECG is an insensitive tool for the detection of pre-symptomatic coronary artery disease. Therefore, identified minor anomaly should provoke further and more comprehensive review. When a resting ECG indicates minor anomaly, a further and fuller review should be carried out to clarify the anomaly, for example using exercise ECG.

The last resting ECG examination of the PIC prior to the incapacitation event was performed in 2021. The result showed that the PIC had sinus rhythm with an anomaly indication of inferior ischemia, which means a regular heartbeat with decreased blood flow to the basal part of the heart caused by blockage of the coronary artery. This anomaly should be clarified for a further and fuller review according to SI 67-02. The PIC anomaly was not clarified for a more comprehensive review as the previous exercise ECG, which was conducted six months before, indicated a normal result. Thereafter, the Aviation Medical Examiner (AME) considered the PIC was fit to fly.

Six months later or about one month before the incapacitation event, the PIC underwent an exercise ECG using Bruce Protocol. This exercise was the last medical examination prior to the occurrence. The PIC completed 8 minutes 30 seconds of exercise ECG and achieved an oxygen uptake equivalent to 10 metabolic equivalents (METs). The exercise was terminated because the PIC had reached his maximum heart rate.

SI 67-02 requires applicants to be exercised and complete at least three stages (nine minutes) of the Bruce protocol or achieve an oxygen uptake equivalent to 11 METs. The test is considered most sensitive when taken to symptom limitation rather than any percentage of the age-predicted maximum. In addition, the ability to complete the 9-minute Bruce protocol on an exercise ECG is linked to a very low risk of cardiovascular disease. Therefore, the PIC's last test duration of less than nine minutes was not in accordance with SI 67-02. Should the exercise be completed in 9 minutes, there will be a greater chance to acquire a more comprehensive cardiovascular examination of the PIC.

The exercise result of the PIC was sent via e-mail among 72 other applicant results to the cardiologist to be interpreted. At that time, the cardiologist who was at a different place interpreted the results and identified a LBBB during the recovery phase of the PIC's exercise ECG. The cardiologist advised all the result interpretation to the nurse and recalled marking the PIC's exercise result as negative with additional instruction to undergo heart computed tomography (CT) scan. However, the nurse recalled to

never have received such instruction, and the heart CT scan of the PIC was not performed. The PIC's medical record provided to KNKT indicated that the PIC's exercise ECG result was marked as negative without any instruction to undergo a CT scan. When providing the instruction to the nurse by a phone call, the cardiologist also advised the interpretation of the ECG result from the other applicants, one by one. The high volume of ECG result, and method of communication might have contributed to the mis-recording of the instruction for the heart CT scan.

The absence of a further and fuller review to clarify the anomaly indication during the last resting ECG, duration of exercise ECG which was less than nine minutes, and absence of heart CT scan during the last medical examination resulted in a missed opportunity to have a more comprehensive review of the PIC's cardiovascular condition.

2.3 Fit Pilot Actions

The PIC acted as Pilot Monitoring (PM), and the Second in Command (SIC) acted as Pilot Flying (PF). After the aircraft climbed past an altitude of 2,400 feet, an alert appeared on the Electronic Centralized Aircraft Monitoring (ECAM) indicating that the Air Pack 2 was still in off position. The SIC then called the PIC, who has the task to switch on the Air Pack 2, and realized that the PIC was incapacitated. The SIC attempted to check the PIC's consciousness, but there was no response which then made the SIC assume that the PIC had fainted.

Citilink Operation Manual Part B1: Standard Operating Procedures and Aircraft Information (OM-B1) subchapter 1.4.17, describes the standard operating procedure for pilot incapacitation contained in the Citilink Operation Manual Part A: General (OM-A) and Citilink Airbus A320 Flight Crew Techniques Manual (FCTM). The OM-A subchapter 15.4 describes 14 sequence actions to be taken by the fit pilot when pilot incapacitation is detected, while the FCTM subchapter PR-AEP-MISC provides seven actions that should be applied by the fit pilot during an incapacitation event (see subchapter 1.12.1.1). The investigation was unable to find any means such as checklist to help the fit pilot memorize all the described sequence actions.

The first three sequence actions to be taken according to the OM-A are to ensure the safe condition of the flight, to take over the aircraft control, and to ensure the autopilot is engaged. Additionally, the FCTM describes that for taking over and ensuring a safe flight path, fit pilot should announce "I have control" and perform callouts (challenge and response included) and checklists aloud. After the incapacitation had been detected, the SIC as PF had control of the aircraft and the autopilot was already engaged. However, the Cockpit Voice Recorder (CVR) did not record any callouts nor checklist was performed aloud by the SIC.

The SIC then asked Flight Attendant 1 (FA1) to come to the cockpit by using the interphone. This action did not comply with the described sequence actions, as the fourth action must be a declaration of an emergency condition to the air traffic control (ATC), thereafter calling the flight attendant using Public Address (PA). In addition, the use of the interphone instead of PA delayed the SIC's ability to perform another sequence action as the SIC had to wait for the FA to respond to the interphone call. The assumption of the PIC had fainted made the SIC did not declare an emergency

condition and only declared urgency message (PAN) to the aircraft operator ground personnel and TMA controller.

The sixth action of the described sequence actions is to take whatever steps to ensure the incapacitated pilot cannot interfere with the handling of the aircraft, which may involve FA to restrain the incapacitated pilot and preparing to administer oxygen using quick donning oxygen system, if needed.

After being aware of the PIC's incapacitation, the FA made an announcement to seek any medical doctor or paramedic onboard and qualified pilot onboard, following the seventh and eighth required actions. As there was no qualified pilot onboard, one of the FA remained in the cockpit in accordance with the described sequence actions.

The ninth action requires the fit pilot to land the aircraft at the nearest suitable airport after considering all pertinent factors. The SIC had decided to return to Surabaya.

The tenth action of the fit pilot is to request medical assistance after landing and provide detailed information about the condition of the incapacitated pilot. However, the SIC did not mention requiring assistance on arrival to the TMA, APP, or Tower controller. The SIC also did not request assistance from the aircraft operator ground personnel until they asked whether ambulance might be required, about 13 minutes after the SIC was aware of the PIC incapacitation.

During the occurrence, the SIC always wore seatbelt and harnesses when seated in accordance with the eleventh sequence action in the OM-A.

The last three described sequence actions in the OM-A are to prepare the approach preparation earlier, to request radar vectoring to make long approach for reducing workload, and to perform the landing from the fit pilot usual seat. The SIC had requested to make 15 minutes holding to avoid an overweight landing by reducing the fuel and lessen his workload from completing the landing preparation. However, when the SIC advised the APP controller to be ready for the landing approach, the medical doctor and the FAs were in the process of laying down the PIC in the cockpit to initiate the cardiopulmonary resuscitation (CPR). Proceeding with the landing approach before completing flight preparation and resuscitation process indicated that the approach preparation was not done properly.

According to the OM-B1 subchapter 2.5.1.2.1, in case of pilot incapacitation, the SIC who seated on the right seat is not allowed to taxi the aircraft, however, SIC may taxi the aircraft to vacate the runway to a safe area and must request assistance to tow the aircraft. After the aircraft landed, the SIC decided to continue taxiing to the apron, considering that the PIC needed immediate medical treatment. This decision was not in accordance with the OM-B1 and, the safe taxi maneuver could not be ensured as the SIC had neither training for taxiing nor experience to taxi the Airbus A320-200 aircraft.

The series of pilot actions during the occurrence indicated that the described sequence action of the OM-A and the detailed guidance in the FCTM were not implemented properly.

The Citilink Operation Manual Part D1: Pilot Training (OM-D1) subchapter 4.1.1.5.2 described that pilot training to handle pilot incapacitation event was categorized as specialized training which must be conducted through both ground and simulator

training which required check or evaluation. Those ground and simulator training for pilot incapacitation exercise required to be conducted every 36 months.

According to the OM-D1 subchapter 4.2.1.5.6, the reference document to conduct pilot incapacitation exercise in Full Flight Simulator (FFS) during Airbus A320 type qualification training were the FCTM subchapter PR-AEP-MISC page 10/32 and an outdated Citilink Airbus A320 Flight Crew Operating Manual (FCOM) subchapter PR-ABN-80. The pilot incapacitation training subject in the line training also used the same reference of FCTM and FCOM with addition of OM-A document. The outdated FCOM described Crew Incapacitation procedure as memory item which requires fit pilot to call FA using the PA, ensure the incapacitated pilot to be restrained, request assistance from any medically qualified passenger, and check if a type of qualified company pilot is on board to replace the incapacitated pilot. Those three different sources of procedure with different steps of action might confuse the pilot during its implementation.

The SIC underwent two exercises of pilot incapacitation during takeoff in an FFS training in 2020 as part of his Airbus A320 type qualification training. In 2022, about five months prior to the occurrence, the SIC also underwent line training that included training subject of pilot incapacitation. Therefore, the frequency of the pilot incapacitation training was in accordance with the aircraft operator's requirement.

The SIC training record indicated that all results of the pilot incapacitation exercise for the SIC were marked as satisfactory without any deficiency comments from the checker. The SIC's incapacitation exercise during the line training was performed following the OM-D1 which conducted by reviewing and discussing the general precaution, recognition of incapacitation, and action to be taken without simulating the incapacitation event.

The SIC had 128 flight hours on type including the training hours which was considered a low flight experience. In addition, the SIC only had one time experience of pilot incapacitation flight handling exercise in a simulator, which was in 2020. The emergency in real flight might have added more pressure compared to the training situation. Therefore, the low experience of the SIC without any means such as checklist to assist the fit pilot in conducting all the 14 sequence actions, resulted in an increased workload during the incapacitation event, which could not be managed properly.

2.4 Handling of Pilot Incapacitation

According to the OM-A subchapter 15.2, a PIC incapacitation event, which indicated by total functional failure and loss of capabilities, was classified as obvious incapacitation. The FCTM subchapter PR-AEP-MISC describes that sometimes a flight crew does not have any symptoms before incapacitation.

Prior to the flight, the PIC underwent a blood pressure check, and the result was within the normal range. According to the other crewmembers who met the PIC on the day of the occurrence, the PIC appeared to be normal and showed no sign of illnesses. Therefore, the obvious incapacitation of the PIC happened without any symptoms that made it unable to be recognized in timely manner.

After realizing the PIC's incapacitation, the SIC called the FA to the cockpit. The FA1 came to the cockpit and assumed the PIC had fainted as she was able to see the PIC's chest movement. Based on this assumption, the FA1 slid the PIC's seat backward, reclined the seat, released the shoulder harness, and loosened the tie. The FA1 then exited the cockpit seeking aromatherapy oil. Releasing the shoulder harness made the PIC unrestrained, and it was not in accordance with the pilot incapacitation procedure. The unrestrained PIC might become a hazard as the PIC arms could interfere with the aircraft handling, especially when the FA1 exited the cockpit. That assumption also made the FA1 attempt to rouse the PIC up with aromatherapy oil rather than administering oxygen to the PIC.

The pilot incapacitation procedure describes in the Citilink Operation Manual Part B2: Flight Attendant Procedures (OM-B2) subchapter 10.8.5 stated that one of the FA duties was to be prepared to administer quick donning oxygen mask, if needed.

The attempt to wake the PIC using the aromatherapy oil was not successful, and then a medical doctor entered the cockpit. After assessing the PIC's condition, the medical doctor advised that the PIC might have heart attack or stroke and asked for supplementary oxygen. Those medical doctor's advice and request were considered a situation that should make the FA prepare administering oxygen using a quick donning oxygen mask, in accordance with the pilot incapacitation procedure. However, as the FA did not familiar with using the quick donning oxygen mask, the FA delivered portable oxygen from the cabin two minutes after the request. As a possible heart attack occurred, the blood supply to the entire body was greatly reduced, resulting in low oxygenation in all organs, including the brain and the heart itself. The delay in administrating oxygen could have deteriorated the incapacitation condition.

The Citilink Operation Manual Part D2: Flight Attendant Training (OM-D2) subchapter 5.3.1.6 described that training to handle crew incapacitation was included in the Safety Emergency Procedure training, and the training to administer oxygen was included in the First Aid training. However, the exercise to administer oxygen in both training utilized portable oxygen, and the use of quick donning oxygen mask was only shown in a video presentation. This absence of real exercise to use quick donning oxygen mask had made the FA decide to seek portable oxygen and influenced to the delay of the oxygen administration.

A few minutes after administration of oxygen, the medical doctor asked the FA to lay down the PIC on the cockpit floor to perform CPR. Prior to commence the second attempt of the landing approach, the SIC informed the FA that the aircraft was about to land and asked to return the PIC to his seat. Two FAs and the medical doctor put the PIC back to his seat, assisted by the SIC. The movement to put back the PIC possessed the risk of causing interference with flight control considering the limited space of the cockpit.

The unrestrained PIC when the FA1 exited cockpit, delays in providing oxygen, and the movement to put back the PIC to his seat indicated that the pilot incapacitation procedure was not carried out to its fullest extent.

The FAs had completed initial and recurrent of the Safety Emergency Procedure training and First Aid training. In addition, all FAs had passed the competency check with satisfactory results without any remarks on either training. The real emergency

might have added more pressure compared to the training situation and influenced the improper implementation of pilot incapacitation procedures.

2.5 Pilot Incapacitation Procedures

As mentioned in the previous analysis, the OM-B1 that contained company's standard operating procedures, described the procedure for pilot incapacitation was contained in the OM-A and FCTM. The OM-A described 14 sequence actions to be taken by the fit pilot when pilot incapacitation was detected, while the FCTM provided seven actions that should be applied for the fit pilot during an incapacitation event. The investigation was unable to find any pilot checklist related to that procedure, meaning that the fit pilot must memorize all the described actions in the OM-A or open the respective documents during the implementation. Without any checklist, an incapacitation event during high workload situation such as takeoff, might add pressure to the fit pilot and affected the capabilities to remember the procedure correctly, especially since the procedure contains many sequenced actions.

One action that needed to be done during the incapacitation event was to be prepared to administer oxygen using a quick donning oxygen mask to the incapacitated pilot if needed. According to OM-A subchapter 15.4, that action was the responsibility of the fit pilot, while the aircraft operator Operation Manual Part B2 (OM-B2) subchapter 10.8.5 described that action as the duty of the FA. However, the investigation was unable to find any detailed guidance or training material to determine the condition that requires the use of quick donning oxygen mask.

The aircraft operator procedure did not include the requirement to verify passengers with medical background. Therefore, when a medical doctor showed up the FA took the medical doctor to the cockpit without verifying his profession. The unverified passenger with medical background might have made the incapacitated pilot not receive proper treatment. Thereafter, two other passengers came to the FA and claimed to be medical doctors. The FA did not bring the other medical doctors to the cockpit as they considered that the cockpit space was too small to accommodate another person. The aircraft operator procedure also did not include the scenario in case multiple passengers with a medical background were onboard. This could contribute to the loss of greater opportunities to treat the PIC, as some medical doctors had more specialized expertise in handling the emergency medical situation, and the teamwork among medical doctors would bring greater benefit to handling such situations.

About 17 minutes after the SIC became aware of the PIC's incapacitation, the FA announced to seek the type of qualified pilot onboard following the described sequence action in the OM-A, and no response from the passengers. The terminology of "type qualified pilot" would narrow the possibility to find any qualified pilot to assist the remaining pilot.

The described sequence actions in the OM-A and OM-B2 required FA other than FA1 to remain in the cockpit, if no type of qualified pilot is available.

The investigation was unable to find detailed information related to specific tasks of the FA remaining in the cockpit in the aircraft operator's documents. However, as it required only when no type of qualified pilot was available, it can be interpreted that the FA remaining in the cockpit should help reducing the fit pilot's workload, such as reading the checklist and guarding the incapacitated pilot.

The mentioned deficiencies from the pilot incapacitation procedures might prevent the effective implementation of fit pilot's and FA's actions to handle the incapacitation event.

3 CONCLUSIONS

3.1 Findings

The findings are statements of all significant conditions, events or circumstances in the accident sequence. The findings are significant steps in the accident sequence, but they are not always causal, or indicate deficiencies. Some findings point out the conditions that pre-existed the accident sequence, but they are usually essential to the understanding of the occurrence, usually in chronological order.

1. The aircraft had a valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R). Prior to and during the flight, there was no report or record of the aircraft system malfunction.
2. The aircraft took off with packs off take off configuration, which means the procedure on take-off by switching off the packs to close the bleed air supply from the engine to the aircraft air conditioning system in order to maximize the engine power.
3. Both pilots held valid pilot licenses and qualified as an Airbus A320 pilot, while all flight attendants (FAs) held valid Flight Attendant Certificate (FAC) with Airbus A320 rating.
4. The Second in Command (SIC) had a valid Class 1 medical certificate without any limitation, while all FAs had a valid Class 2 medical certificate without any limitation.
5. The Pilot in Command (PIC) underwent medical examination every six months at *Balai Kesehatan Penerbangan* (Aviation Medical Center). The medical examination included the test of fasting blood glucose, kidney function, liver function, lipid profile, uric acid, exercise Electrocardiogram (ECG) using Bruce Protocol and resting ECG
6. The medical examination records of the PIC in the last five years showed that the cholesterol level constantly recorded above the determined normal value by the Aviation Medical Center, the PIC was in an overweight condition and an active smoker.
7. PIC had been an active smoker for 30 years, with average daily consumption was a pack of cigarettes (16 cigarettes) per day. The PIC was also being asked to quit smoking by the Aviation Medical Center in 2021, and until the day of the occurrence the PIC was still smoking.
8. Directorate General of Civil Aviation (DGCA) Staff Instruction (SI) 67-02 subchapter I.3 described high cholesterol level, smoking, and obesity was included as vascular risk factors which can increase risk of coronary events such as heart attack.
9. Civil Aviation Safety Regulation (CASR) Part 67 nor SI 67-02 did not require pilots with vascular risk factors to be assessed as unfit during medical examinations. However, SI 67-02 subchapter I.4 described that the vascular risk factors should be intervened even before the declared disease, especially if there are multiple risk factors present.

10. The PIC had been recommended medical interventions, including regular exercise and a low-fat diet. Given that the PIC's cholesterol level never exceeded 320 mg/dL, the PIC did not receive a referral for statin therapy from the Aviation Medical Center and it was not required by the SI 67-02. The investigation also did not find any information that the PIC was on statin therapy.
11. CASR Part 67 subpart 67.201 described that any abnormality of the heart or abnormal cardiac rhythm must be assessed as unfit. One of the methods to determine abnormality of the heart or abnormal cardiac rhythm is using ECG examination.
12. CASR Part 67 subpart 67.203 described the resting ECG must be reexamined for an applicant with age above 40 years at the first six months and followed with exercise ECG (Treadmill Stress Test/TMT) at the next six months or vice versa.
13. SI 67-02 subchapter I.2 described that resting ECG is an insensitive tool for the detection of pre-symptomatic coronary artery disease. When resting ECG indicated minor anomaly, a further and fuller review should be carried out to clarify the anomaly, for example using exercise ECG.
14. The PIC's exercise ECG results in 2020 and 2021 showed that the physical condition degraded from good to average condition and remained during the last exercise ECG in 2022.
15. The resting ECG result on 8 December 2021, showed that the PIC had sinus rhythm with an anomaly indication of inferior ischemia which means a regular heartbeat with decreased blood flow to the basal part of the heart caused by blockage of the coronary artery.
16. The PIC's resting ECG anomaly result on 8 December 2021 was not clarified for a further and fuller review as the previous exercise ECG, which was conducted six months before, indicated a normal result. Thereafter, the Aviation Medical Examiner (AME) considered the PIC was fit to fly.
17. In the last medical examination on 6 June 2022, which was performed about a month prior to the occurrence, the vascular risk factors remained. This condition indicated that the intervention to mitigate the vascular risk factors did not success.
18. SI 67-02 requires applicants to be exercised and complete at least three stages (nine minutes) of the protocol or achieve an oxygen uptake equivalent to 11 METs.
19. During the last medical examination, the PIC underwent exercise ECG using Bruce Protocol and completed 8 minutes and 30 seconds. The PIC achieved an oxygen uptake equivalent to 10 metabolic equivalents (METs) during the exercise.
20. The completion of the exercise ECG of the PIC during the last medical examination was based on the condition that the maximum heart rate was already reached.
21. The ability to complete the 9-minute Bruce protocol on an exercise ECG is linked to a very low risk of cardiovascular disease.
22. The cardiologist who interpreted the PIC's last exercise ECG identified a Left Bundle Branch Block (LBBB) during the recovery phase of PIC's exercise ECG.

23. The cardiologist advised the PIC's last exercise ECG result along with the other 72 results via phone one by one and recalled marking the PIC exercise result as negative with additional instruction to undergo heart computed tomography (CT) scan. However, the nurse recalled never receiving such instruction. The number of ECG results and method of communication might have contributed to the mis-recording of the instruction.

24. The cardiologist's instruction for the PIC to undergo heart CT scan was not found on PIC's medical record and the heart CT scan was not performed. The exercise ECG result of the PIC marked as negative.

25. The AME granted the PIC a Class 1 Medical Certificate considering that all the examination results met the requirement, including the exercise ECG result was negative, no hypertension and diabetes.

26. The absence of a further and fuller review to clarify the anomaly indication during the last resting ECG, duration of exercise ECG which was less than nine minutes and absence of heart CT scan during the last medical examination, resulted in the loss of the opportunity to have a more comprehensive review of the cardiovascular condition of the PIC.

27. PT Citilink Indonesia had not developed a health monitoring system for maintaining the health of crewmember.

28. According to the Citilink Operation Manual Part A: General (OM-A) subchapter 15.2, the incapacitation event which indicated by total functional failure and loss of capabilities, was classified as obvious incapacitation.

29. Citilink Airbus A320 Flight Crew Techniques Manual (FCTM) subchapter PR-AEP-MISC described that sometimes a flight crew does not have any symptoms before incapacitation.

30. During the occurrence flight, the PIC acted as Pilot Monitoring (PM) and the SIC acted as Pilot Flying (PF).

31. The SIC realized that the PIC incapacitated when the SIC called the PIC who had the task to switch on the Air Pack 2 after an alert appeared on the Electronic Centralized Aircraft Monitoring (ECAM) when the aircraft was climbing and passed an altitude of 2,400 feet.

32. The SIC noticed that the PIC was in rigid posture. Thereafter, the SIC called and tapped the PIC's right thigh and shoulder, however there was no response which then made the SIC assume that the PIC was faint.

33. Prior to the occurrence flight, the PIC underwent alcohol and blood pressure check, and the result was within the normal range. The other crewmembers who met the PIC on the day of the occurrence stated that the PIC appeared to be normal and showed no sign of any illnesses.

    The obvious incapacitation of the PIC happened without any symptoms that made it unable to be recognized in a timely manner.

34. Citilink Operation Manual Part B1: Standard Operating Procedures and Aircraft Information (OM-B1) subchapter 1.4.17, described the standard operating procedure for pilot incapacitation contained in the OM-A and FCTM.

35. OM-A subchapter 15.4 described 14 sequence actions to be taken by the fit pilot when pilot incapacitation was detected, while FCTM subchapter PR-AEP-MISC provided seven actions that should be applied by the fit pilot during incapacitation event. The investigation was unable to find any means such as a checklist to help the fit pilot memorize all the described sequence actions.

36. After the incapacitation had been detected, the SIC as PF had control of the aircraft and the autopilot was already engaged. However, the Cockpit Voice Recorder (CVR) did not record any callouts nor checklist was performed aloud by the SIC as required by the FCTM.

37. The SIC asked Flight Attendant 1 (FA1) to come to the cockpit by using the interphone to advise the PIC's incapacitation. This action did not comply with the described sequence actions, as fit pilot must declare an emergency condition to the air traffic control (ATC) thereafter calling the flight attendant using Public Address (PA).

38. The use of the interphone instead of PA reduced the time that can be used by the SIC to perform another sequence action as SIC have to wait for the FA to respond to the interphone call.

39. The assumption of the PIC had fainted made the SIC did not declare an emergency condition and only declared urgency message (PAN) to the aircraft operator ground personnel and TMA controller.

40. FA1 came to the cockpit and assumed the PIC was faint as she was able to see the PIC's chest movement. Based on this assumption, the FA1 slid the PIC's seat backward and reclined the seat, then released the shoulder harness, and loosened the tie.

41. The release of the shoulder harness made the PIC unrestrained, and it was not in accordance with the pilot incapacitation procedure. The unrestrained PIC might become a hazard as the PIC arms could interfere with the aircraft handling, especially when the FA1 exited the cockpit.

42. FA1 went out from cockpit seeking aromatherapy oil to rouse the PIC up rather than administering oxygen to the PIC as FA1 assumed that the PIC had fainted. The attempt to wake up the PIC using the aromatherapy oil was not successful.

43. After being aware of the PIC incapacitation, the FA made an announcement to seek any medical doctor onboard. The aircraft operator procedure did not include the requirement to verify passengers with medical background nor the condition in the case of more than one passenger with medical background onboard.

44. After the FA announcement to seek any medical doctor on board, a passenger claimed to be a medical doctor showed up and the FA took the passenger to the cockpit without verifying the profession of the passenger. The unverified passenger with medical background might have made the incapacitated pilot not be treated properly.

45. The FA did not bring the other two passengers who claimed as medical doctors to the cockpit as they considered that the cockpit space was too small if another person added in the cockpit. This could contribute to the loss of greater

opportunities to treat the PIC, as some medical doctors had more specific ability in handling the emergency medical situation and the teamwork among medical doctors would bring greater benefit to handling such situation.

46. About 17 minutes after the SIC was aware of the PIC incapacitation, the FA announced to seek any type of qualified pilot onboard following the described sequence action in the OM-A, and there was no response from the passengers. The terminology of "type qualified pilot" would narrow the possibility to find any qualified pilot to assist the remaining pilot.

47. The described sequence actions in the OM-A and OM-B2 required FA other than FA1 to remain in the cockpit, if no type of qualified pilot is available.

48. The investigation was unable to find detailed information related to the task of the FA remaining in the cockpit in the aircraft operator documents. However, as it required only when there is no type of qualified pilot, it can be interpreted that the FA remaining in the cockpit should help to reduce the fit pilot's workload, such as reading the checklist and guarding the incapacitated pilot.

49. The deficiencies from the pilot incapacitation procedures might prevent the effective implementation of fit pilot and FA actions to handle the incapacitation event.

50. The medical examination to the PIC from the medical doctor during the occurrence flight found that the PIC was pulseless followed by no breathing, there was no sign of stomach illness, respiratory problem, or neurological problem.

51. The medical doctor suspected the PIC had a heart attack or stroke. Considering that the PIC had several vascular risk factors, the incapacitation was likely due to heart attack. The possibility of cardiovascular events resulting from inadequate intervention measures to remove vascular risk factors might have rendered the PIC incapacitated.

52. The medical doctor's advice that the PIC might have heart attack or stroke and asked for supplementary oxygen should make the FA prepare administering oxygen using a quick donning oxygen mask, in accordance with the pilot incapacitation procedure.

53. The FAs had received training to handle crew incapacitation and training the training to administer oxygen. However, the exercise to administer oxygen in both training utilized portable oxygen, and the use of quick donning oxygen mask was only showed in a video presentation.

54. The absence of real exercise to use quick donning oxygen mask had made the FA decide to seek portable oxygen and influenced to the delay of the oxygen administration.

55. As a possible heart attack occurred, the blood supply to the entire body was greatly reduced, resulting in low oxygenation in all organs, including the brain and the heart itself. The late administration of oxygen could deteriorate the incapacitation condition.

56. When the SIC advised the APP controller to be ready for the landing approach, the medical doctor and the FAs were in the process of laying down the PIC in the cockpit to initiate the cardiopulmonary resuscitation (CPR).

57. The decision to continue the landing approach while the flight preparation and resuscitation process have not been completed indicated that the approach preparation was not prepared properly.

58. Prior to commence the second attempt of the landing approach, the two FAs and the medical doctor put the PIC back to his seat, assisted by the SIC. The movement to put back the PIC possessed the risk of causing interference with flight control considering the limited space of the cockpit.

59. After the aircraft landed, the SIC decided to continue taxiing to the apron, considering that the PIC needed immediate medical treatment. The continuation taxiing the aircraft to the apron was not in accordance with the OM-B1 and the safe taxi maneuver could not be ensured as the SIC never been trained for taxi training nor had experience to taxi the Airbus A320-200 aircraft.

60. Several improper actions by the fit pilot and the FA indicated that the pilot incapacitation procedure was not carried out to its fullest extent.

61. Citilink Operation Manual Part D1: Pilot Training (OM-D1) subchapter 4.1.1.5.2 described that pilot training to handle pilot incapacitation event was categorized as specialized training which must be conducted every 36 months on the ground and simulator training which required check or evaluation.

62. According to the OM-D1 subchapter 4.2.1.5.6, the reference document to conduct pilot incapacitation exercise was the FCTM subchapter PR-AEP-MISC page 10/32, an outdated Citilink Airbus A320 Flight Crew Operating Manual (FCOM) subchapter PR-ABN-80 and OM-A. Every document had different steps of action which might confuse the pilot during its implementation.

63. The frequency of the SIC's pilot incapacitation training was in accordance with the aircraft operator's requirement. The SIC training record indicated that all results of the pilot incapacitation exercise for the SIC were remarked as satisfactory without any deficiency comments from the checker.

64. The SIC incapacitation exercise on the pilot line training was performed following the OM-D1 which conducted by reviewing and discussing the general precaution, recognition of incapacitation and action to be taken without simulated the incapacitation event.

65. SIC had 128 flight hours on type including the training hours which was considered a low flight experience.

    In addition, the SIC only had one time experience of pilot incapacitation flight handling exercise in simulator back in 2020.

66. The FAs had completed the initial and recurrent of the Safety Emergency Procedure training and First Aid training. In addition, all FAs had passed the competency check with satisfactory results without any remarks on either training.

67. The real emergency might have added more pressure compared to the training situation and influenced the improper implementation of pilot incapacitation procedures.
68. The low experience of the SIC without any means such as checklist to assist the fit pilot in conducting all the 14 sequence actions, resulted in the increasing workload during the incapacitation event could not be managed properly.

3.2 Contributing Factors

Contributing factors is defined as actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident.

The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability. The presentation of the contributing factors is based on chronological order and not to show the degree of contribution.

KNKT concluded the contributing factors are as follows:

- The absence of a further and fuller review to clarify the anomaly indication during the last resting ECG, the duration of exercise ECG which was less than nine minutes, and the absence of heart computed tomography (CT) scan during the last medical examination resulted in a loss opportunity to have a more comprehensive review of the Pilot in Command (PIC)'s cardiovascular condition.
- The possibility of cardiovascular events resulting from inadequate intervention measures to mitigate vascular risk factors might have rendered the PIC's incapacitation.

4 SAFETY ACTIONS

At the time of issuing this investigation report, the KNKT had been informed safety actions taken by the Directorate General of Civil Aviation and the aircraft operator.

4.1 Directorate General of Civil Aviation

On 29 July 2022, the Directorate General of Civil Aviation (DGCA) issued a circular letter with number *SE 06 Tahun 2022* about the health monitoring system of aircrew. This health monitoring system should be conducted by a medical team. This medical team will analyze the medical condition, put special concern on the crew who are having risk of medical fitness degradation including for ensuring the medical intervention to reduce the health risk are implemented properly.

4.2 Citilink Indonesia

On 11 August 2023, Citilink Indonesia hired a company doctor following the issuance of circular letter number *SE 06 Tahun 2022* by the DGCA.

On 12 February 2025, Citilink Indonesia evaluated and revised the pilot incapacitation procedures to ensure that the action taken by the fit pilot can be carried out to its fullest extent during an incapacitation event, including:

- added additional task for flight attendants to conduct a proper verification of passenger with a medical background.
- revised the announcement to seek "type qualified pilot" with "a company flight crew (of any type rating) to increase the possibility of finding any pilot to assist the fit pilot.
- added task of flight attendant remaining in the cockpit during pilot incapacitation event.

4.3 *Balai Kesehatan Penerbangan* (Aviation Medical Center)

On 27 July 2022, Balai Kesehatan Penerbangan (Aviation Medical Center) performed Framingham Risk Score (FRS) calculation to further evaluate the condition of the pilots conducting medical examination.

The Framingham Risk Score is a simplified and common tool for the assessment of risk level of coronary artery disease (CAD) over 10 years. The FRS considers several coronary risk factors, including age, gender, cholesterol, smoking habits, and systolic blood pressure. FRS is the most applicable method for predicting the person's chance of developing cardiovascular disease (CVD) in long term. Because this risk score gives an indication of the likely benefits of prevention, it can be useful for both the patients and clinicians deciding whether lifestyle modification and preventive medical treatment and for patients education by identifying men and women at increased risk for future cardiovascular events.[27]

[27] This description of this subchapter is based on article on this following link Framingham risk score for estimation of 10-years of cardiovascular diseases risk in patients with metabolic syndrome | Journal of Health, Population and Nutrition | Full Text (biomedcentral.com)

5 SAFETY RECOMMENDATIONS

KNKT acknowledges the safety actions taken by the related parties and considered that the safety actions were relevant to improve safety, however there are still safety issues remaining to be considered. Therefore, KNKT issued safety recommendations to address safety issues identified in this report.

The safety recommendation in this investigation report is made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident.

5.1 Citilink Indonesia

- **04-O-2022-10.01**

  In the last Pilot in Command (PIC) medical examination, which was performed about a month prior to the occurrence, the vascular risk factors remained. This condition indicated that the intervention to mitigate the vascular risk factors did not success. The possibility of cardiovascular events resulting from inadequate intervention measures to remove vascular risk factors might have rendered the PIC's incapacitation.

  After the occurrence, the Directorate General of Civil Aviation (DGCA) issued a circular letter requiring air carriers to establish a health monitoring system for aircrew. This health monitoring system should be conducted by a medical team. This medical team will analyze the medical condition, put special concern on the crew who are having risk of medical fitness degradation, and ensure the medical intervention to reduce the health risk is implemented properly.

  Citilink Indonesia has established an agreement with a medical clinic regarding the management of health services for Citilink Indonesia's aircrew. However, KNKT has not received the evidence of implementing a health monitoring system to put special concern to crewmembers who are at risk of medical fitness degradation and make sure the appropriate medical intervention is used to lower the health risk.

  Therefore, KNKT recommends that Citilink Indonesia to establish a health monitoring system as mandated by the DGCA circular number *SE 06 Tahun 2022* for ensuring medical intervention to reduce the health risk are implemented properly.

- **04-O-2022-10.02**

  According to the Citilink Operation Manual Part D1: Pilot Training (OM-D1) subchapter 4.2.1.5.6, the reference document to conduct pilot incapacitation exercise in Full Flight Simulator (FFS) during Airbus A320 type qualification training are the Citilink Airbus A320 Flight Crew Techniques Manual (FCTM) subchapter PR-AEP-MISC page 10/32 and an outdated Citilink Airbus A320 Flight Crew Operating Manual (FCOM) subchapter PR-ABN-80. The pilot incapacitation training subject in the line training also used the same reference of FCTM and FCOM with the addition of Citilink Operation Manual Part A: General (OM-A) document. Those three different sources of procedure with different steps of action might confuse the pilot during its implementation.

Therefore, KNKT recommends that Citilink Indonesia review the reference documents for pilot incapacitation training for to ensure that the training implementation is conducted using current and valid document to avoid confusion during its implementation.

- **04-O-2022-10.03**

  Citilink Operation Manual Part D2: Flight Attendant Training subchapter 5.3.1.6 describes that training to handle crew incapacitation was included in the Safety Emergency Procedure training, and the training to administer oxygen was included in the First Aid training. However, the exercise to administer oxygen in both training programs utilized portable oxygen, and the use of quick donning oxygen mask was only showed in a video presentation. This absence of real exercise to use quick donning oxygen mask had made the FA decide to use portable oxygen from the cabin and influenced to the delay of the oxygen administration. The late administration of oxygen could have deteriorated the incapacitation condition.

  Therefore, KNKT recommends that Citilink Indonesia evaluate the training materials for ensuring the flight attendant can administer oxygen as soon as it needed, including proper use of quick donning oxygen mask.

- **04-O-2022-10.04**

  During the incapacitation event, the Flight Attendant (FA) made an announcement to seek a medical doctor on board, and a passenger claimed to be a medical doctor showed up. Thereafter, two other passengers came to the FA and claimed to be medical doctors. The FA did not bring the other medical doctors to the cockpit as they considered that the cockpit space was too small to accommodate another person.

  The aircraft operator did not have a procedure which included the scenario in case of multiple passengers with medical background were onboard during the incapacitation event. More than one medical doctor may have more specialized expertise in handling the emergency medical situation, and the cooperation among medical doctors may bring greater benefit.

  Therefore, KNKT recommends that Citilink Indonesia review crew incapacitation procedure to consider the potential benefits of involving more than one medical doctor in handling incapacitation event.

5.2 *Balai Kesehatan Penerbangan* (Aviation Medical Center)

- **04-R-2022-10.05**

  Directorate General of Civil Aviation Staff Instruction (SI) 67-02 requires applicants to undergo exercise testing and complete at least three stages (nine minutes) of the protocol or achieve an oxygen uptake equivalent to 11 metabolic equivalents (METs) using the Bruce Protocol. Based on a study conducted by Marshall et al. (2010), the ability to manage nine minutes of the Bruce Protocol during exercise Electrocardiographic (ECG) is associated with a very low risk of subsequent cardiovascular events.

  During the last medical examination, the Pilot in Command (PIC) underwent an exercise ECG using the Bruce Protocol. The PIC completed 8 minutes and 30

seconds of the protocol and achieved an oxygen uptake equivalent to 10 METs during the exercise. The exercise was stopped based on the condition that the maximum heart rate was already reached. The duration of less than nine minutes was not in accordance with SI 67-02. Should the exercise be completed in 9 minutes, there will be a greater chance to acquire a more comprehensive cardiovascular examination of the PIC.

Therefore, KNKT recommends that Aviation Medical Center consider an exercise ECG that does not meet the minimum requirement of three stages (nine minutes) or an oxygen uptake equivalent to 11 METs as a potential risk for subsequent cardiovascular event which must triggers further evaluation.

- **04-R-2022-10.06**

The last exercise Electrocardiographic (ECG) of the Pilot in Command (PIC) was conducted by a nurse at Cardiology Polyclinic at Aviation Medical Center. The exercise result was sent via e-mail along with the result of 72 other applicants to the cardiologist to be interpreted. At that time, the cardiologist identified a Left Bundle Branch Block (LBBB) during the recovery phase of the PIC's exercise ECG. The cardiologist instructed the nurse via phone to undergo heart computed tomography (CT) scan to the PIC. However, the nurse recalled to never receiving the instruction. The instruction was not found on PIC's medical record and the heart CT scan was not performed. When providing the instruction to the nurse over the phone, the cardiologist also advised the interpretation of the ECG result from the other 72 applicants one by one. The high volume of ECG results and method of communication might have contributed to the mis-recording of the instruction properly. The absence of a heart CT scan contributed to a missed opportunity to have further and more thorough review of the PIC's cardiovascular condition.

Therefore, KNKT recommends that Aviation Medical Center evaluates the procedures of reporting the ECG results for ensuring that all instructions from the cardiologist are delivered and performed appropriately.

5.3 Directorate General of Civil Aviation

- **04-R-2022-10.07**

The Pilot in Command (PIC)'s resting Electrocardiographic (ECG) result on 8 December 2021, showed a sinus rhythm with an anomaly indicating inferior ischemia which means a regular heartbeat with decreased blood flow to the basal part of the heart caused by a blockage in a coronary artery.

The PIC's resting ECG anomaly result was not clarified for a further and fuller review as the previous exercise ECG conducted six months earlier, indicated a normal result. Thereafter, the Aviation Medical Examiner (AME) considered the PIC fit to fly.

Directorate General of Civil Aviation Staff Instruction (SI) 67-02 subchapter I.2 describes that resting Electrocardiographic (ECG) is an insensitive tool for the detection of pre-symptomatic coronary artery disease. When resting ECG indicates minor anomaly, a further and fuller review should be carried out to clarify the anomaly, for example using exercise ECG. This condition resulted in the PIC's resting ECG anomaly was not clarified which contributed to a missed opportunity

to have further and more comprehensive review of the PIC's cardiovascular condition.

Therefore, KNKT recommends that Directorate General of Civil Aviation reviews the Staff Instruction (SI) 67-02 to ensure the anomalies identified during resting ECG to be clarified for a more comprehensive review of applicant's cardiovascular condition.

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