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Medically Related Pilot Incapacitation Event Data Pathways for Safety Assurance in Part 121 Operations

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16. Abstract

MITRE was tasked by the Federal Aviation Administration's (FAA's) Office of Aerospace Medicine (AAM) to document how safety-related incapacitation events involving Part 121 aircrews are recorded and reported to FAA. Through a series of anonymized, voluntary interviews with knowledgeable Part 121 carrier personnel, MITRE assessed these processes over four broad areas.

1. Air carrier procedures: All Part 121 carrier respondents require crews to report pilot incapacitation events once the aircraft has landed safely. Part 121 carrier procedures for responding to pilot incapacitation events followed two consistent paths, with information being routed through either an operational/management department or a safety investigation department.
2. Timing, content, and mechanisms: All Part 121 carriers focus on meeting the regulatory timing and content requirements for incidents set forth by 49 CFR § 830, but differences in carrier data reporting and the low frequency of incidents selected for investigation by the National Transportation Safety Board limit the event information available. While this information may be communicated to the FAA in several ways, there are indications that data are not being captured completely or consistently. Even if the FAA collects these data, they are not typically updated as new information becomes available or discovered, and they are not easily accessible to AAM for analysis and trending.
3. The reporting of pilot incapacitation events in their Safety Management Systems (SMS): There are several ways that a "pilot incapacitation event" can lead to an SMS review within a Part 121 air carrier, but medically caused events are rare and unique enough that their safety assurance might not register as a hazard to instate new risk controls.
4. The degree to which the air carrier could conform to a standardized reporting process to the FAA: All Part 121 air carrier personnel interviewed for this work believed their organizations would be willing to share protected data with the FAA if those efforts sufficiently defined safety research or improvement goals. Several interviewees suggested studying these data as special initiatives within existing efforts and working groups rather than forming new consortia.

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INTRODUCTION AND PROJECT BACKGROUND

The medical incapacitation of any essential aviation crew member during flight can jeopardize the safety of operations. The International Civil Aviation Organization's (ICAO's) *Manual of Civil Aviation Medicine*, in its third edition, dedicates a chapter to the complexities of flight crew incapacitation events (ICAO, 2012). Although regular safety examinations and medical certification processes are effective in ensuring the safe performance of aviation personnel, sudden incapacitations still happen (Government Accountability Office, 2008; Federal Aviation Administration, 2012b; Matthews & Stretanski, 2023). These rare incidents make it challenging to collect and analyze data to identify trends (Evans & Radcliffe, 2012). The Federal Aviation Administration (FAA) once studied pilot incapacitation using Medical Case Alert forms and the Incapacitation Data Registry (IDR), but those efforts were halted and did not fulfill a safety assurance role (Larcher & DeJohn, 2021). Prior research has shown the difficulty in collecting data to understand incapacitation rates among pilots to guide decision-making (DeJohn et al., 2006).

The FAA's Office of Aerospace Medicine (AAM), specifically the Medical Specialties Division (AAM-200), aims to ensure that pilot incapacitation events remain below certain thresholds as part of regulatory risk management. These data are crucial for setting the FAA's risk tolerance for policy decisions and ensuring compliance with ICAO standards and AAM safety management responsibilities (FAA, 2021a). The increasing likelihood of single pilot operations and the introduction of Advanced Air Mobility into the National Airspace System highlight the importance of these data (Asokan & Cameron, 2023; Myers III & Starr Jr, 2021). Moreover, advancements in medical technologies could expand medical certification opportunities for pilots with specific conditions (Brokaw et al., 2022).

With the IDR database discontinued, there is no centralized system to collect, monitor, and assess the scope and nature of pilot incapacitation issues (Larcher & DeJohn, 2021). Public databases maintained by the FAA, National Transportation Safety Board (NTSB), and other entities do not consistently record such events, suggesting that reports of pilot incapacitations are scattered across multiple locations, some of which may be unknown to AAM. This dispersal prevents the effective use of data for AAM's operational needs. If events are reported, concerns arise about data completeness and whether the FAA's medical certification and safety assurance activities have the necessary information to ensure pilots are medically fit, to correctly issue certificates, and to update their guidance, materials, and requirements for medical certification (FAA, 2023a; FAA, 2018b).

This project aimed to shed light on the procedures for reporting pilot incapacitation at Part 121 operators to better understand how data are managed post-event. Such insights could help AAM enhance its safety assurance functions.

To achieve this, four broad task areas were identified as follows:

1. The air carrier procedures (involving crew, operations, etc.) in response to a pilot incapacitation;
2. The timing, content, and mechanisms of how air carriers report pilot incapacitation events to the NTSB and/or FAA;
3. The ways in which air carriers incorporate pilot incapacitation events into their Safety Management Systems (SMS), specifically Safety Risk Management (SRM) and Safety Assurance (SA); and

4. The extent to which air carriers could adhere to a standardized reporting process to the FAA, possibly as part of a cooperative safety assurance process.

STUDY APPROACH AND PROFILE OF RESPONDENTS

The FAA assigned MITRE the task of enhancing AAM's understanding of how medical-related pilot incapacitation events involving Part 121 carriers are documented and reported. This effort aligns with the requirements of 49 CFR 830.5 and aims to improve the development of safety assurance functions. To achieve this, MITRE used its aviation expert network to identify individuals willing to openly discuss the handling of pilot incapacitation event data within their organizations. Appendix B presents a matrix detailing participants' anonymized roles, responsibilities, and expertise from Part 121 carriers and other pertinent entities. This matrix also provides an estimation of the completeness of their contributions to the research findings. Surveyed experts included both former and current Part 121 pilots, data reporting program managers, medical specialists, safety investigators, SMS consultants, and other aviation industry professionals.

A severe pilot incapacitation may lead to a fatality or an accident, as defined by the NTSB (Title 49, 2011). In such instances, detailed data from comprehensive NTSB investigations are expected to be accessible to the FAA (NTSB, n.d.a). As a participant in these investigations, the FAA has access to these data (NTSB, n.d.c). The Medical Accident Review and Hazard Analysis Program oversees the maintenance and analysis of autopsy, medical, and toxicology data within systems like the Document Imaging Workflow System (Aviation Medicine Advisory Service, n.d.), Medical Analysis and Tracking (Hunn et al., 2020), and ToxFlo (United States Department of Transportation, FAA, 2022). Cases involving evidently impaired pilots are also expected to be captured by the NTSB, FAA, and air carrier testing and reporting mechanisms and are likely reviewed by the Aerospace Medical Certification Division (AMCD) for certification purposes (Alcohol or Drugs, 2024).

The discussions were structured around the four identified areas of interest, but conversations were not constrained if participants shifted focus to share relevant experiences related to pilot incapacitation events, data reporting practices, and safety management procedures. None of the respondents had personally experienced or witnessed a pilot incapacitation event, and only two were aware of such incidents occurring within their organizations. All respondents believed it unlikely for a pilot incapacitation leading to an aviation accident (Title 49, 2011) to go unnoticed by the NTSB or FAA. To foster productive discussions, interviewees were encouraged to describe the procedures and processes their organizations would follow if a medically related incapacitation incident met the criteria for an NTSB-reportable event (Title 49, 2011).

STUDY RESULTS

Task Area 1. The Air Carrier (Crew, Operations, etc.) Procedures in Response to a Pilot Incapacitation

Task Area 1 Summary: *All Part 121 carrier respondents require crews to report pilot incapacitation events after the aircraft has safely landed. The procedures for addressing pilot incapacitation within Part 121 carriers generally follow one of two paths, with information*

being directed through either an operational/management department or a safety investigation department.

The ICAO advises that operators provide crew members with emergency incapacitation training (ICAO, 2012). However, only one pilot distinctly remembered receiving training on how to respond to a pilot incapacitation before starting their operational duties, and they could not recall any further or continuous training.

The procedures for responding to pilot incapacitation are documented in the flight operations manuals (FOM) of all Part 121 carriers involved in this study. Some carriers have checklists in the FOM or electronic flight bags that include the ICAO-recommended actions for managing such events (ICAO, 2012). An interviewee from one carrier noted that while their FOM covers how to handle crew incapacitation events, it deliberately downplays checklist usage, instead "empowering" staff to rely on their judgement and experience in emergency situations.

After ensuring the flight's safety, FOM procedures instruct crews to report pilot incapacitations to a dispatch or operations center as promptly as possible. Depending on the flight phase and the workload required to maintain safety, crew members are encouraged to report incidents in flight when possible, to either the operator's dispatch, in-flight medical service providers, air traffic control (ATC), or through the Aircraft Communications, Addressing, and Reporting System. Early notifications can facilitate the arrangement of emergency medical services to meet the aircraft upon landing and provide assistance as needed.

All carriers require that crew report incidents once the aircraft is safely on the ground. Dispatch services are tasked with collecting and sharing key event details with relevant parties within and outside the organization. The complexity of dispatch operations often reflects the size of the carrier's operations. Dispatch typically records events using enterprise management software that monitors various operational incidents from initial report to resolution. These data are tracked and directed through these systems as needed. Depending on factors like the specific carrier processes, urgency, and personal preference, phone calls and emails are sometimes employed for internal communication.

When a potential pilot incapacitation is reported to dispatch, the process for deciding on external reporting typically involves one of two pathways. In some carriers, initial high-level event details are directed to safety-focused contacts, such as an on-duty investigator, safety investigation department, or a specialized "response team" consisting of experts from throughout the company to address unique or complex situations. In other cases, the information first goes to operational and/or management staff like the chief pilot or flight operations duty manager (FODM) at the time of the event. Respondents from more than one carrier indicated that executive staff would be informed early to plan any necessary corporate responses based on the event's public or media attention. Regardless of the initial direction, pertinent event information is shared between safety and operations teams as needed to facilitate external communications with regulatory bodies like the NTSB or FAA.

Interviewees highlighted that pilots suspected of experiencing a medically related incapacitation are temporarily removed from the schedule until cleared to return to duty. The corporate medical office or the chief medical officer typically oversees the process for assessing their fitness for duty. Pilots diagnosed with a condition that currently prevents them from obtaining a medical certificate are governed by 14 CFR § 61.53 and are prohibited from operating any aircraft that requires such certification (Prohibition on operations during medical deficiency, 2022). The chief

pilot or FODM initially informed of the incident often coordinates between the pilot (and their union representation, if involved) and the corporate medical office.

If the air carrier's procedures determine an event meets the NTSB's reporting criteria, communications with the Board are usually handled by a designated point of contact (POC) in the operator's safety investigations department, who tend to have established relationships with NTSB investigators and knowledge of the necessary notifications and forms. An illustrative figure and table detailing a standard Part 121 air carrier's response to pilot incapacitation events can be found in Appendix D.

Task Area 2. The Timing, Content, and Mechanisms by which the Airlines Report Pilot Incapacitation Events to the NTSB and/or FAA

Task Area 2 Summary: *All carriers operating under Part 121 focus on adhering to the regulatory requirements for timing and content of incident reports as specified by 49 CFR § 830. However, variations in how carriers report data and the NTSB's selective approach to investigating incidents result in incomplete event information. Although there are multiple channels through which this information can be relayed to the FAA, evidence suggests that these data are not consistently or fully captured. Furthermore, even when the FAA collects these data, updates are rare as new information emerges, and access to the data for analysis and trend identification by AAM is not straightforward.*

NTSB Reporting

The FAA permits "large, U.S.-based airlines, regional air carriers, and all cargo operators" (FAA, 2023e) to operate under 14 CFR Part 121, which encompasses domestic, flag, and supplemental operations. These operators must comply with the immediate notification requirement outlined in 49 CFR § 830.5, which mandates:

> "the operator… shall immediately, and by the most expeditious means available, notify the nearest National Transportation Safety Board (NTSB) office, when: (a) An aircraft accident or… serious incidents occur… [such as] … Inability of any required flight crewmember to perform normal flight duties as a result of injury or illness…,"

including events triggered by medically induced pilot incapacitation. To determine if an event meets the immediate notification criteria, some operators contact the NTSB for guidance, while others decide independently and then notify the NTSB. In both scenarios, communication with the NTSB typically occurs within two to three hours of the event.

Should the Part 121 carrier or the NTSB conclude that an event warrants immediate notification, operators are required to report specific data items listed in 49 CFR § 830.6 "Information to be given in notification," provided such information is available, including:

- "(a) Type, nationality, and registration marks of the aircraft;
- (b) Name of owner, and operator of the aircraft;
- (c) Name of the pilot-in-command;
- (d) Date and time of the accident;
- (e) Last point of departure and point of intended landing of the aircraft;
- (f) Position of the aircraft with reference to some easily defined geographical point;
- (g) Number of persons aboard, number killed, and number seriously injured;

- (h) Nature of the accident, the weather, and the extent of damage to the aircraft, so far as is known; and
- (i) A description of any explosives, radioactive materials, or other dangerous articles carried (Information to be given in notification, n.d.)"

It is crucial to note that 49 CFR § 830.2 defines terms such as *aircraft accident*, *fatal injury*, *incident*, and *serious injury* (Definitions, 2011), but it does not clarify the meaning of *serious incident*, *injury*, and *illness* as mentioned in 49 CFR § 830.5. Likewise, 49 CFR § 830 does not explicitly define terms related to pilot or crew member incapacitation.

Aircraft operators gather details from the crew involved, witnesses, and any accessible sources pertaining to the incident. These operators notify the NTSB's 24-hour Response Operations Center (ROC) (NTSB, n.d.b) with the required information listed in 49 CFR § 830.6, as available. Notification typically occurs within two to three hours of the incident. Some operators include a brief summary of the preliminary facts of the incident along with the specified items (a)-(i) from 49 CFR § 830.6, via email or telephone. In cases where notifications are emailed, it is common for operators to follow up with a phone call to ensure the NTSB has received them.

The NTSB Investigator-In-Charge (NTSB-IIC) may respond to the air carrier's submission in several ways: 1) an email acknowledgment with a "no action" number, effectively closing the case; 2) a request for additional information through phone or email to decide whether the carrier needs to complete and submit an NTSB Form 6120.1 as specified in 49 CFR § 830.15 (Reports and statements to be filed, n.d.); or 3) initiation of an investigation, providing the carrier with an incident or accident number and requesting the submission of NTSB Form 6120.1, typically through email. There is also a possibility that the NTSB may not respond to a Part 121 carrier's submitted information.

If requested to fill out Form 6120.1, Part 121 carriers usually provide the necessary data within hours to days following the incident, with more complex events requiring more time. This form allows the NTSB to assign probable causes, which could include pilot incapacitation as a cause or contributing factor (NTSB, n.d.d). If the NTSB requires additional information, such as media, crew and witness interviews, or other records, these are provided as they become available or are discovered throughout the investigation. Interviewees have noted that the NTSB seldom decides to investigate incidents unless they are actively researching a specific type of incident, with turbulence-related injuries being a recent focus (NTSB, 2021). Consequently, additional data on potential pilot incapacitation incidents may not be widely accessible. Experiences from at least one respondent indicate that the NTSB often bases its final reports on accidents and incidents primarily on the information provided in Form 6120.1. Appendix E includes a figure and table summarizing the processes for disseminating event information to the NTSB.

FAA Reporting

The FAA disseminates information on aviation incidents through its Emergency Operations Network (EON) (U.S. Department of Transportation, 2002). This system aggregates reports from various sources and ensures that relevant FAA offices, the NTSB, federal officials, security partners, and aviation stakeholders are informed of incidents via communication tools within the system (U.S. Department of Transportation, 2002). As a result, EON serves as a key source for AAM to learn about these incidents.

Valuable data might be captured if a pilot or crew member communicates with ATC before or during an event suggesting potential pilot incapacitation. If not immediately identified, any confusion or unusual responses to ATC instructions can offer insights, especially if explicit declarations of a serious medical event, such as a stroke or heart attack, occur during flight. The FAA's safety inspectors also monitor for deviations from expected performance through the Safety Performance Analysis System, which could indicate pilot incapacitation (U.S. Department of Transportation Volpe Center, 2013).

In the event of an investigation into such an incident, the NTSB-IIC and the FAA's corresponding investigator (FAA-IIC) will collaborate closely. The FAA, always a participant in NTSB investigations (NTSB, n.d.), shares its findings with the NTSB (FAA, 2018). The FAA, particularly through its Flight Standards District Offices (FSDOs), may also alert the NTSB about unusual events. It publishes reports on recent aviation incidents and accidents through the Accident and Incident Data System (AIDS), offering a preliminary overview subject to change and containing only basic details (National Archives and Records Administration, 2021; United States Department of Transportation, 2022).

The FAA-IIC, often based in an FSDO and guided by the Accident Investigation Division (AVP-100), records accident and incident details on Form 8020-23, entered into the Air Traffic Quality Assurance (ATQA) system. This documentation process starts within 30 days of the incident but may not be updated with ongoing findings or the NTSB's final conclusions (FAA, 2021). Once completed, Form 8020-23 undergoes a final review before being added to the AIDS database (FAA, 2018a). This form includes specific fields to indicate pilot incapacitation as a factor in the incident (FAA, 2012a).

Interviewees mentioned that medically related events identified during investigations are reported to the FAA by medical officers through the regional flight surgeon (RFS) (FAA, 2023c; FAA, 2019). However, there is hesitance and privacy concerns about merging medical data with broader safety investigation findings. Air carriers use the term "personal medical event" to describe information they would not require from an employee unless it is deemed relevant to regulatory reporting. Decisions on a pilot's fitness for duty involve the pilot, their Aviation Medical Examiner (AME), and other medical professionals, in consultation with the RFS.

Respondents highlighted the Aviation Safety Action Program (ASAP) as a valuable source for data on pilot incapacitation (FAA, 2023g; FAA, 2022a; FAA, 2020). They believe ASAP reports are an effective method for collecting data not captured by other FAA and NTSB processes, partly because these programs offer protections from punitive actions, encouraging reporting. The FAA's role in the Event Review Committee (ERC) process is crucial for identifying misfiled reports related to medical incapacitations, per Advisory Circular 120-66C (FAA, 2020). While reports from the incapacitated pilot are rejected, those from other crew members are accepted and can provide insights into the incident. The ERC process is seen as robust, involving FAA inspectors, airline management, and pilot union representatives. Rejected ASAP reports concerning pilot incapacitation are communicated to the RFS and the operator's medical offices, who work together on medical certification issues (FAA, 2020).

Other Sources of Reporting

The IDR emphasizes the need for proactive discovery and collection of related information to compile a comprehensive record of pilot incapacitation events (Larcher & DeJohn, 2021). These processes are crucial for AAM to stay informed of such events and collect the necessary operational data.

The Aviation Safety Reporting System (ASRS), managed by the National Aeronautics and Space Administration (NASA), is highlighted as a valuable resource for information on reported pilot incapacitation (FAA, 2022b; NASA, n.d.). Although the ASRS database provides a high-level overview and ensures anonymity, it includes a specific field for "pilot incapacitation" and allows for keyword searches within the narratives. Should the ASRS analysts deem a report significant, it is then shared with the FAA (and the NTSB) for potential further action (FAA, 2022).

Additionally, several sources mentioned the use of Irregular Operations Reports (IOR or IROPS) for reporting pilot incapacitation events (FAA, 2023c). Each aircraft operator manages these reports through a centralized review system, which may escalate the event to the RFS or the NTSB based on the event's severity and nature. It is also anticipated that crew members involved in such events would submit corresponding ASAP reports along with their IORs.

Lastly, one operator highlighted that certain incapacitation incidents leading to crew member injuries might necessitate reporting to the Occupational Safety and Health Administration (OSHA) or the National Institute for Occupational Safety and Health (NIOSH) due to their implications on occupational safety (OSHA, n.d.; NIOSH, 2023).

Task Area 3. Whether and How the Air Carriers Address Pilot Incapacitation Events in Their SMS (SRM/SA)

Task Area 3 Summary: *Within Part 121 air carriers, several pathways can trigger an SMS review due to a "pilot incapacitation event." However, events caused by medical reasons are infrequent and distinct, often not perceived as significant enough to introduce new risk controls.*

Air carriers typically identify three main triggers for an SMS analysis:

1. Routine monitoring indicates systematic issues – showing an increasing trend.
2. The occurrence of a significant event or issue.
3. Requests from leadership, particularly in response to media coverage of an event.

Most respondents highlighted that the consideration of an event for potential "NTSB reporting" marks a critical juncture in their operational processes, invariably leading to an SMS review. However, none indicated that pilot incapacitation events are specifically tracked as a metric within their organizations' safety management systems. Among those interviewed with knowledge of the NTSB, the process of identifying and reporting accidents was seen as more straightforward than that for incidents, with at least one respondent attributing this to clearer regulatory definitions of an accident compared to an incident (Title 49, 2011). ASAP reports and other voluntary safety reporting mechanisms are key resources in SMS analysis (FAA, 2021b).

Should an event be considered but not meet the criteria for NTSB reportability, some respondents mentioned they would still proceed with an internal investigation, although at least one specified they would not, especially if the event involved a "personal medical event." This term was used by more than one carrier to describe temporary conditions not indicative of a broader medical issue, with gastrointestinal distress often cited as a common example. Such instances are generally not seen as triggers for an SMS review.

All respondents indicated that if the NTSB initiates an investigation into an event, the air carrier will conduct a concurrent internal investigation to support the NTSB's efforts (NTSB, n.d.c). The nature and details of the incident or accident guide the information collected during these investigations. Two individuals who reported recent pilot incapacitation events outside their organization mentioned that these incidents did not lead to any updates in their SMS.

Task Area 4. The Degree to Which Air Carriers Could Conform to a Standardized Reporting Process to the FAA

Task Area 4 Summary: *Personnel from all Part 121 air carriers interviewed for this study expressed their organizations' willingness to share protected data with the FAA, provided the goals for safety research or improvement are clearly defined. Several interviewees recommended analyzing these data within the framework of existing efforts and working groups instead of creating new consortia.*

Respondents uniformly recognized medically related pilot incapacitation events as rare but believed they are effectively managed and monitored through existing FAA medical certification requirements, NTSB oversight, safety reporting programs, and Part 121 processes, including internal investigations and, in some instances, SMS. Interviewees showed strong support for the ASAP and similar models like the Air Traffic Safety Action Program (FAA, 2021c), applauding their role in standardizing data collection and promoting a culture of reporting. The concept of sharing data in a secure manner, where only insights from the data are disseminated, was particularly valued.

The discussion around a standardized reporting process, its resource implications, the voluntary nature of participation, and the specific objectives of a "collaborative safety assurance process" emerged as the most challenging topic for respondents. However, they were generally open to engaging in data collaboration aimed at safety research or improvement, provided the objectives are well articulated. Some suggested that air carriers might seek protections under 14 CFR Part 193 for voluntarily submitted information (Protection of Voluntarily Submitted Information, 2001). Despite no Part 121 carrier representatives identifying pilot incapacitation as a significant risk warranting new safety measures in their processes, there was a consensus on supporting the FAA in developing new safety initiatives. The industry's involvement in a recent NTSB pilot mental health roundtable was cited as an example of their commitment to collaborating with federal agencies on safety matters (Russell, 2023).

Several interviewees saw potential in examining pilot incapacitation events as part of the FAA's NextGen initiatives (FAA, 2023d), with some highlighting the success of anonymized data sharing initiatives like the Aviation Safety Information Analysis and Sharing (ASIAS) program (FAA, n.d.a). Suggestions were made to engage with the ASIAS Executive Board or the Commercial Aviation Safety Team (CAST) for conducting targeted studies on these events within existing programs (CAST, 2022). Existing systems such as ASAP and ASRS, which may contain data on pilot incapacitation events, are already utilized within ASIAS. Some respondents noted positive outcomes from participating in data sharing and benchmarking initiatives with other carriers through platforms like Airlines for America (2024). The Ground Handling Operations Safety Team (GHOST) was mentioned as another example of effective safety data sharing models for potential voluntary consortia (UK Civil Aviation Authority, 2024).

POTENTIAL NEXT STEPS

Based on the insights gained in this research, MITRE suggests the following ways the FAA can enhance the aviation community's understanding of pilot incapacitation, improve visibility into related data collection, and enhance AAM's capacity to gather relevant information for oversight purposes:

1. Suggest training guidelines to aid aircraft operators in enhancing crew members' abilities to accurately identify and respond to pilot incapacitation incidents, with a focus on subtle or partial incapacitations.
2. Engage in dialogue with Civil Aviation Authorities with higher rates of pilot incapacitation reporting to explore methods for overcoming data capture barriers and address potential reluctance to report (Protection of Voluntarily Submitted Information, 2001).
3. Collaborate with aircraft operators to create a best practices guide for responding to pilot incapacitations. This guide should detail the specific data to be collected, the recipients of the data, the timing of data submission, and the purpose of the data collection. Aim for a program that moves beyond regulatory compliance to voluntary cooperation, with the FAA playing a crucial role in disseminating trend data to motivate participation.
4. Update the process for AAM to systematically gather, organize, and assess information following a pilot incapacitation incident to assess the need for a collaborative data-sharing partnership with Part 121 operators to enhance existing reporting mechanisms.
    a. AAM should review the effectiveness of data collection, synthesis, and analysis methods utilized in the IDR's development and upkeep to refine their safety assurance activities (Larcher & DeJohn, 2021). The data elements and fields established should be reassessed for availability, effort required to collect, quality, and relevance to pilot incapacitation event analysis and surveillance (Larcher & DeJohn, 2021).
5. Ensure coordination with FAA departments responsible for maintaining critical databases like AIDS (United States Department of Transportation, 2022) and ATQA to secure access to high-quality (i.e., confidential) data for those involved in safety assurance, with an eye towards future data sharing frameworks like Enterprise Information Management (Cowell & Eberhardt, 2015). Develop strategies for enhancing data accuracy as new event details emerge.
6. Explore acquiring data from unconventional sources such as in-flight aviation medical service providers, SMS providers for Part 135 operators, Facility Operations ATC logs (FAA, 2023c), and the National Traffic Management Log (FAA, 2023f), especially to complement data not reported through EON.
7. Consider introducing non-punitive protections for voluntarily shared data to enhance safety, for instance, under 14 CFR Part 193, to foster participation from Part 121 operators in future data-sharing initiatives.
8. Continue collaboration with the NTSB to gain deeper insights into crew member or pilot incapacitation data it collects, including:
    a. Exploring differences in notification and reporting among Part 121 air carriers. While data routing processes are generally consistent, variations in 49 CFR 830.5 reporting could affect the data received by the NTSB.
        i. Address concerns among some air carriers about noncompliance with NTSB reporting requirements, which leads to more cautious reporting. The FAA should work with the NTSB to understand if the data received includes pilot incapacitation information, particularly from carriers that report conservatively without prior NTSB consultation. Some carriers believe they might report incidents to the NTSB of which the FAA is unaware.

b. Clarify the criteria for classifying pilot incapacitation events as incidents to standardize data collection.
    i. For pilot incapacitation incidents labeled as "no action" by the NTSB, it is possible the NTSB collects data from Part 121 operators that is not shared with the FAA due to the lack of investigation into these events. The FAA needs to assess how much these gaps affect the availability of data on pilot incapacitations.
c. Examine the criteria for NTSB's decision to investigate incidents, as inconsistent investigation choices could create data availability gaps.
d. Assess how incapacitation data are maintained, the consistency of data collection ensured, and how data are reported to the FAA.
e. Explore joint research efforts on pilot incapacitation events, similar to the NTSB's work on preventing turbulence-related injuries (NTSB, 2021).

9. Collaborate with aircraft operators to establish a clear and comprehensive definition of pilot incapacitation types that pose safety risks and should be integrated into SMS, including SRM and SA processes.
10. Propose a special initiative through CAST (2022) or the General Aviation Joint Safety Committee (GAJSC, 2023) focused on pilot incapacitation events to analyze safety trends using protected data.

LIMITATIONS OF THIS STUDY

This study faced several limitations. The short duration limited our ability to collect standardized data through formal methods, such as an industry questionnaire. Instead, we relied on pre-existing relationships with aviation experts and cooperative personnel from Part 121 operators to obtain the necessary information. Larger airlines, with their complex organizational structures, presented a challenge due to multiple internal data points and various knowledgeable personnel, making them more time-consuming to navigate. In contrast, staff at smaller airlines often had a broader and sometimes complete understanding of the inquiries made. This research's voluntary nature also posed a limitation, as the value of sharing information was not clear to operators. To mitigate this, we focused on individuals most open to frank discussions, ensuring anonymity and confidentiality to foster honesty. While we identified common processes and themes, the insights are limited to the practices of the Part 121 operators interviewed and the expertise and opinions of the contributors.

CONCLUSION

The FAA aims to medically certify pilots to ensure they are physically and mentally capable of safely operating aircraft, thereby preventing accidents and incidents stemming from medical conditions. AAM's objective is to refine the certification process by employing data and technology for informed, risk-based decisions. Central to this goal is a thorough understanding of pilot incapacitation events. The discontinuation of the IDR has left a gap in the centralized collection, monitoring, and analysis of data on pilot incapacitations, complicating efforts to gather such data. Operators typically believe that medically related pilot incapacitations leading

to accidents would be identified and investigated by the NTSB and the FAA, with airline cooperation (NTSB, n.d.c). However, capturing data on partial incapacitations or incidents that do not disrupt airline operations proves more challenging, especially when incidents are perceived as "personal medical events" or temporary conditions not indicative of ongoing medical issues.

ASAP reports, particularly from non-incapacitated crew members, are viewed as the most viable source of data for events not captured by other FAA and NTSB processes. Despite airlines' efforts to investigate these incidents and integrate findings into their SMS, such events' unique and rare nature often precludes them from being recognized as hazards that necessitate new risk controls. None of the Part 121 carrier representatives with recent pilot incapacitation event experience deemed the risk high enough to warrant new controls within their safety management practices. The consensus is that current FAA medical certification requirements, NTSB oversight, other safety reporting programs, and internal processes, like investigations and SMS, adequately manage, analyze, and mitigate medically related pilot incapacitation risks.

To enhance the aviation community's understanding of pilot incapacitations, improve visibility into collected data, and better support AAM's informational needs, the FAA could benefit from the willingness of the community to share protected data for clearly defined safety research or improvement objectives. Participants recommended exploring special initiatives within existing frameworks and working groups (e.g., ASIAS, CAST, or the GAJSC) to study these data rather than establishing new consortia. Before initiating new data-sharing programs with airlines, AAM might explore leveraging existing safety-focused data-sharing partnerships to acquire this information.

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Appendix A Abbreviations and Acronyms

AIDS	Accident and Incident Data System
AMCD	Aerospace Medical Certification Division
AME	Aviation Medical Examiner
ASAP	Aviation Safety Action Programs
ASIAS	Aviation Safety Information Analysis and Sharing
ASRS	Aviation Safety Reporting System
ATC	Air Traffic Control
ATQA	Air Traffic Quality Assurance
AVP-100	Office of Accident Investigation & Prevention, Accident Investigation
AVS	Office of Aviation Safety
AVS/AAM	Office of Aerospace Medicine
AVS/AAM-200	Office of Aerospace Medicine, Medical Specialties Division
CAST	Commercial Aviation Safety Team
EON	Emergency Operations Network
ERC	Event Review Committee
FAA	Federal Aviation Administration
FAA-IIC	FAA Investigator in Charge
FODM	Flight Operations Duty Manager
FOM	Flight Operations Manuals
FSDO	Flight Standards District Offices
GAJSC	General Aviation Joint Safety Committee
GHOST	Ground Handling Operations Safety Team
ICAO	International Civil Aviation Organization
IDR	Incapacitation Data Registry
IOR or IROPS	Irregular Operations Report
NASA	National Aeronautics and Space Administration
NIOSH	National Institute for Occupational Safety and Health
NTSB	National Transportation Safety Board
NTSB-IIC	NTSB Investigator in Charge
OSHA	Occupational Safety and Health Administration
POC	Point of Contact
RFS	Regional Flight Surgeon
ROC	Response Operations Center
SA	Safety Assurance
SMS	Safety Management Systems
SRM	Safety Risk Management

Appendix B Matrix of Respondents, Roles, and Expertise

Task Area 1	Task Area 2	Task Area 3	Task Area 4	Respondent	Organizational Role or Subject Expertise
C	C	I	I	Major Air Carrier A	Pilot
P	I	P	I	Major Air Carrier A	Former Pilot
C	P	C	C	Major Air Carrier A	Safety Data Program Manager
I	C	C	C	Major Air Carrier A	Safety Investigations Manager
C	C	P	C	Major Air Carrier B	Pilot
C	C	C	C	Major Air Carrier C	Safety Investigations Manager
C	C	C	P	Regional/Low-Cost Air Carrier A	Director of Flight Safety
C	C	C	C	Regional/Low-Cost Air Carrier B	Safety Data Program Manager, Former Safety Investigator
C	C	C	C	Regional/Low-Cost Air Carrier C	SMS Consultant
S	S	S	S	Stakeholder A	ASRS Project Manager
P	P	I	I	Stakeholder B	FAA Data Systems Expert
I	P	I	I	Stakeholder C	NTSB Investigator
S	S	S	S	Stakeholder D	Physician & Aviation Health Expert
P	P	I	I	Union A	Safety Representative

- Nine (9) interviewees representing six (6) Part 121 operators
- Four (4) interviewees representing other aviation stakeholders, largely consulted for historical and contextual information
- One (1) incomplete interview with a union representative

Key
C = Information completely satisfied task area
P = Information partially satisfied task area
I = Information insufficiently satisfied task area
S = Provided general information supportive of the task
Stakeholders = aviation experts outside of Part 121 carriers but familiar with relevant processes and data systems

Appendix C Process Diagram Key

data transmission

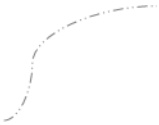
phone communication

response to data request

e-mail communication

infrequent data transmission

enterprise software system



related entities

alternative processes
(differences across operators)

process or action

data transfer or process
timing

entity or data source

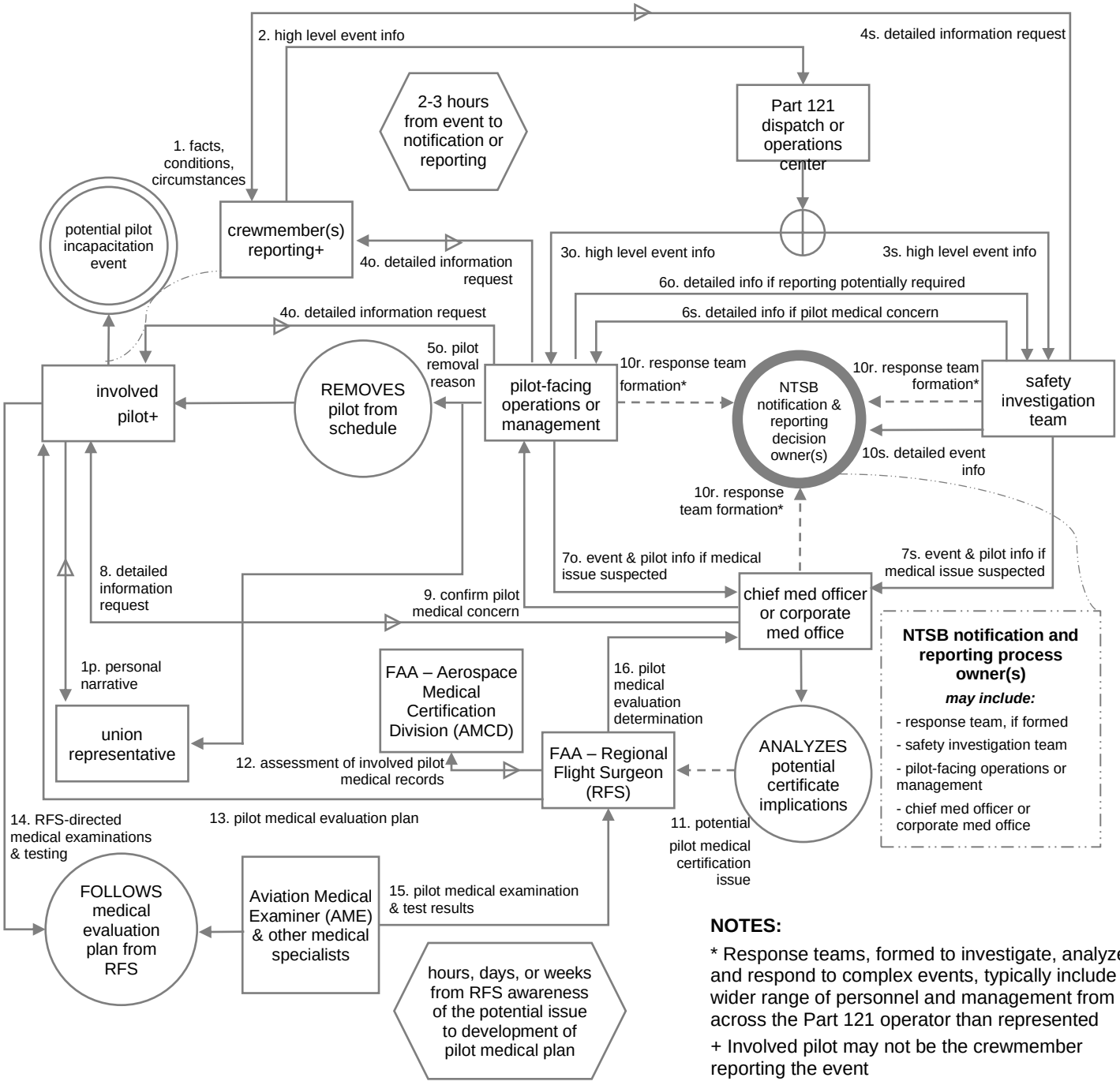
process start

Data STORE TYPES

DB	Database
EMS	Enterprise Management Software
FORM	Official data form

process stop

Appendix D Part 121 On-Ground Pilot Incapacitation Response and Reporting Process



NOTES:

* Response teams, formed to investigate, analyze, and respond to complex events, typically include a wider range of personnel and management from across the Part 121 operator than represented

+ Involved pilot may not be the crewmember reporting the event

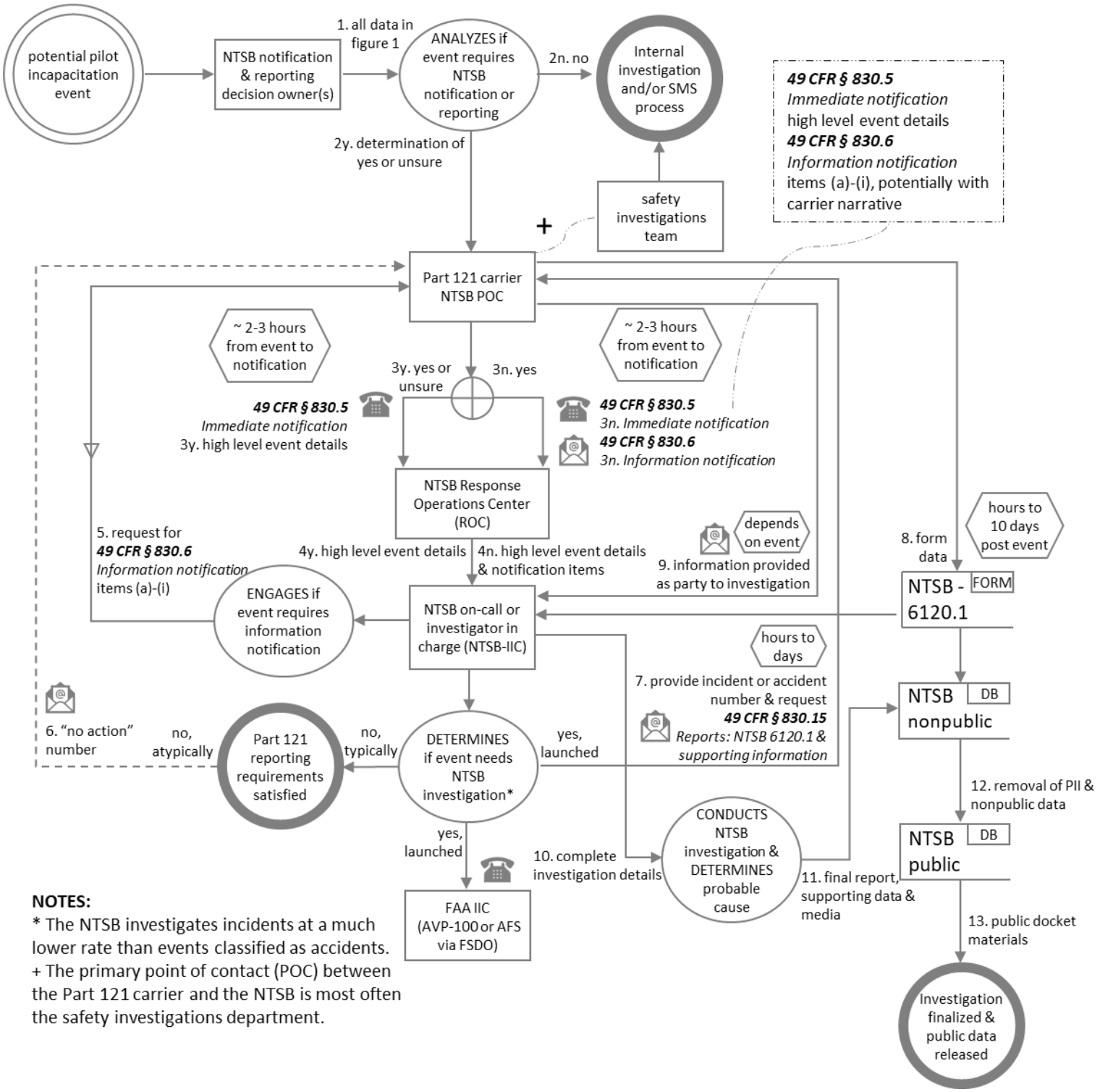
Table D0. Part 121 On-Ground Pilot Incapacitation Response and Reporting Process

STEP #	DATA	SOURCE or ENTITY	RECIPIENT	METHOD
1	facts, conditions, and circumstances	potential pilot incapacitation event	pilot or crewmember(s) reporting	O
1p	personal narrative	involved pilot	pilot's union representation	T
2	high level event info	involved pilot or crewmember(s) reporting	part 121 dispatch or operations	T
3o	high level event info	Part 121 dispatch or operations	pilot-facing operations or management	E, M, T
3s	high level event info	Part 121 dispatch or operations	safety investigation team	E, M, T
4o	detailed information request	pilot-facing operations or management	pilot or crewmember(s) reporting	T
4s	detailed information request	safety investigation team	pilot or crewmember(s) reporting	T
5o	pilot removal reason	pilot-facing operations or management	involved pilot	T, M
6o	detailed info if reporting potentially required	pilot-facing operations or management	safety investigation team	E, M, T
6s	detailed info if pilot medical concern	safety investigation team	pilot-facing operations or management	E, M, T
7o	event & pilot info if medical issue suspected	pilot-facing operations or management	chief med officer or corporate med office	E, M, T
7s	event & pilot info if medical issue suspected	safety investigation team	chief med officer or corporate med office	E, M, T
8	detailed information request	chief med officer or corporate med office	involved pilot	T
9	confirm of pilot medical concern	chief med officer or corporate med office	pilot-facing operations or management	T
10s	detailed event info	safety investigation team	NTSB notification & reporting decision owner(s)	M
10r	response team formation	Cross-organizational team comprised of safety, management, medical, and other relevant personnel	NTSB notification & reporting decision owner(s)	E, M, T
11	potential pilot medical certification issue	chief med officer or corporate med office	FAA – Regional Flight Surgeon (RFS)	E, T
12	assessment of involved pilot medical records	FAA – Regional Flight Surgeon (RFS)	FAA – Aerospace Medical Certification Division (AMCD)	E, M, T
13	pilot medical evaluation plan	FAA – Regional Flight Surgeon (RFS)	involved pilot	T
14	RFS-directed medical examinations & testing	involved pilot	Aviation Medical Examiner (AME) & other medical specialists	O
15	pilot medical examination & test results	Aviation Medical Examiner (AME) & other medical specialists	FAA – Regional Flight Surgeon (RFS)	E, M, T
16	pilot medical evaluation determination	FAA – Regional Flight Surgeon (RFS)	chief med officer or corporate med office	E, T

E: email
M: enterprise management software
O: observed or hearsay
T: telephone call

p = pilot data path
o = operations/management data path
s = safety investigations data path
r = response team data path

Appendix E Part 121 Operator NTSB Notification & Reporting Process



NOTES:

* The NTSB investigates incidents at a much lower rate than events classified as accidents.

\+ The primary point of contact (POC) between the Part 121 carrier and the NTSB is most often the safety investigations department.

Table E1. Part 121 Operator NTSB Notification & Reporting Process

STEP #	DATA	SOURCE or ENTITY	RECIPIENT	METHOD
1	all data in figure 1	NTSB notification & reporting decision owner(s)	ANALYZES if event requires NTSB notification or reporting	E, M, O, T
2y	determination of yes or unsure	NTSB notification and reporting process owner(s)	Part 121 carrier NTSB POC	M
2n	determination of no	NTSB notification and reporting process owner(s)	Internal investigation and/or SMS process	M
3y	49 CFR § 830.5 immediate notification & high level event details	Part 121 carrier NTSB POC (reporting with NTSB guidance)	NTSB Response Operations Center (ROC)	T
3n	yes determination, 49 CFR § 830.5 Immediate notification, high level event details, & 49 CFR § 830.6 items (a)-(i), potentially with carrier narrative	Part 121 carrier NTSB POC (reporting without NTSB guidance)	NTSB Response Operations Center (ROC)	E, T
4y	high level event details & notification items	NTSB Response Operations Center (ROC)	NTSB on-call or investigator in charge (NTSB-IIC)	E, T
4n	high level event details	NTSB Response Operations Center (ROC)	NTSB on-call or investigator in charge (NTSB-IIC)	T
5	request for 49 CFR § 830.6 information notification items (a)-(i)	NTSB on-call or investigator in charge (NTSB-IIC)	Part 121 carrier NTSB POC	E
6	“no action” number	NTSB on-call or investigator in charge (NTSB-IIC)	Part 121 carrier NTSB POC	E
7	provide incident or accident number, request 49 CFR § 830.15 Reports: NTSB 6120.1 & supporting information	NTSB on-call or investigator in charge (NTSB-IIC)	Part 121 carrier NTSB POC	E
8	form data	Part 121 carrier NTSB POC	NTSB Form-6120.1	E
9	information provided as party to investigation	Part 121 carrier NTSB POC	NTSB on-call or investigator in charge (NTSB-IIC)	E, T
10	complete investigation details	NTSB on-call or investigator in charge (NTSB-IIC)	NTSB nonpublic DB	M
11	final report, supporting data & media	NTSB-IIC	NTSB nonpublic DB	M
12	removal of PII & nonpublic data	NTSB nonpublic DB	NTSB public DB	M
13	public docket materials	NTSB public DB	public release	M

E: email

M: enterprise management software

O: observed or hearsay

T: telephone call

n = notification and reporting without NTSB guidance

y = notification and reporting with NTSB guidance

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