

Blackspot Treatment of Accident-Prone Road in Narogong, Bekasi, Indonesia

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ABSTRACT:

Blackspot treatment is a necessary action to reduce accident and victim severity. In addition to the treatment, the cost of the treatment must be considered in order to achieve effectiveness and efficiency in treatment action. In dealing with blackspot treatment on Narogong Road in Bekasi City, the benefit-cost ratio (BCR) method is used to analyze the feasibility of the treatment. In the analysis process, 10 accidents are used that resulted in 4 deaths, 2 serious injuries, and 4 minor injuries according to the National Police's Integrated Road Safety Management System (IRSMS). The recommended treatment is the installation and maintenance of signs, the repair of disabled-friendly pedestrian facilities, repainting the marked crosswalk, the construction and maintenance of sidewalks. Furthermore, the treatment recommendations given resulted in a BCR value of 1.1, or in other words, these recommendations were declared feasible and could provide greater benefits when compared to the treatment costs incurred.

KEYWORDS Road safety analysis, blackspot, treatment, management

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I. BACKGROUND

In 2030, the World Health Organization (WHO) estimates that road traffic accidents will be the fifth cause of death in the world after heart disease, stroke, lung disease, and respiratory infections (WHO, 2013). One of the Sustainable Development Goals (SDGs) is to minimize, reduce, and protect the environment by setting a target of reducing the severity of traffic accident victims by 50% by 2030 (SDGs, 2015). The Indonesian government itself has set a General Plan for National Safety, which has a target that is in line with the SDG's program, namely reducing the severity of accident victims by 75% in 2030 (RUNK, 2022).

Bekasi is one of the supporting cities for Jakarta, besides Tangerang, Bogor, and Depok. It is also a city for commuters working in Jakarta. Aside from being a residential area, it is also developing industrial and trade areas. As a result, transportation in Bekasi City is critical for all groups. The National Police's Integrated Road Safety Management System (IRSMS) database shows the number of traffic accidents in Bekasi City in 2019-2021 was 1909. The data also shows that the total number of victims reached 2433, consisting of 267 deaths, 290 seriously injured, and 1876 minor injuries (IRSMS, 2021).

Based on the seven methods of determining blackspots, the frequency method is a better method in terms of accuracy for determining blackspots compared to other methods (Laukuan, 2011). Based on the results of blackspot identification in Bekasi City using the frequency method, the locations with the highest number of accidents causing death and serious injuries were on Narogong Road. Of the 10 accidents that occurred at that location, 4 died, 2 seriously injured and 4 minorly injured. Blackspot management needs to overcome the problems mentioned above. Treatment should be easy and feasible to implement.

II. OBJECTIVE

The purpose of this research is to make recommendations for treatment plans that consider the circumstances at the Bekasi City blackspot spots that were discovered.

III. METHODS

Accident costs in developing countries, particularly in Indonesia, are subject to a number of changes that take into account various costs, both direct and indirect, and are tailored to the local conditions. (Sugiyanto, 2017).

Table1 Accident Cost by Type of Severity (IDR)

Severity	Accident Cost (IDR)
Death	263,025,681
Serious Injury	12,066,000
Minor injury	1,904,313
Property Damage Only (PDO)	1,562,909

Source: (Sugiyanto, 2017)

The cost of blackspot treatment is calculated from the cost of road equipment used to reduce accidents that occur on the road. The unit cost refers to the unit price determined by the road equipment procurement and installation provider. Indonesia has a technical guide on road safety engineering issued by the Directorate General of Highways, Ministry of Public Works of the Republic of Indonesia with number 02/IN/Db/2012 of 2012. Where in the guide there are guidelines for handling blackspots,

especially in the procurement and installation of road equipment.

The impact of the recommended treatment is quantified in Rupiah (IDR) value by comparing the benefit-cost ratio (BCR) between the savings in accident costs after handling and handling costs. The results of the BCR calculation can provide an overview for stakeholders to choose and determine what treatment should be prioritized first. If the value of $BCR > 1$, treatment is feasible, and vice versa.

IV. DESCRIPTIVE DATA

The blackspot location is on Narogong Road, which is 4/2 D road type and 14 m wide. This road section has a sidewalk width of 0.5 m and a median width of 0.2 m. Currently, the road is in good condition with an asphalt pavement type and relatively low side friction. The number of accidents that occurred at blackspot locations was 10, which can be summarized as follows.

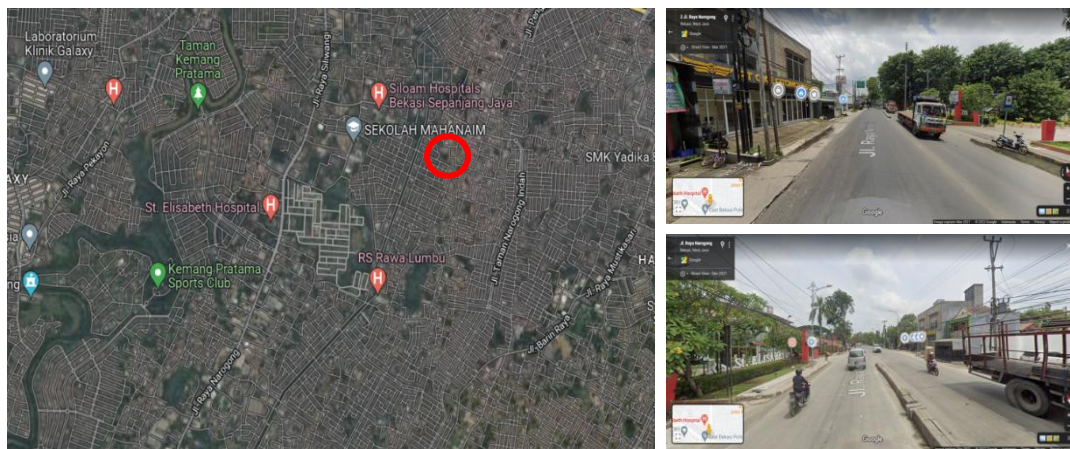


Fig.1 Blackspot Location on Narogong Road (In front of Elisabeth Hospital, Bekasi)

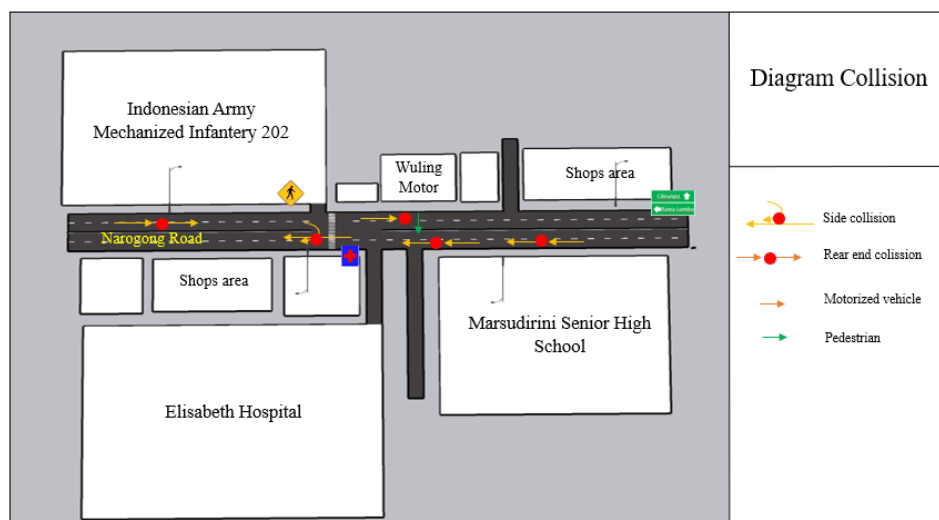


Fig.2Diagram Collision on Narogong Road (In front of Elisabeth Hospital, Bekasi)

V. TREATMENT RECOMMENDATIONS

Affordability of treatment with a measurable reduction rate is critical in determining the benefit-cost ratio obtained when dealing with blackspot locations. Traffic signs and markings function as a control tool that enhances traffic safety and order on the highway (Ahmadian, 2014). Road signs and markings communicate important information, such as warnings, guidelines, and directions to drivers and other road users. Messages are conveyed through words

and/or symbols and signs (Hashim Al-Madani, 2002). Therefore, the design of traffic signs and road markings must be clear, precise, and communicate effectively with users to make them easier to understand. This will prevent road traffic conflicts and lane deviations in the traffic environment (Vilchez, 2018). These road signs and markings must meet requirements such as fulfilling needs, commanding attention, communicating clear and simple messages, respecting road users, and providing sufficient time for appropriate responses (Hashim Al-Madani, 2002).

Table 2 Identification of Possible Causes of Accidents and Proposed Handling Analysis

No	Identification of Possible Causes of Accident	Recommendation	Reference
1	There is a median opening in front of the entrance of Elisabeth Hospital, which is used as access to Elisabeth Hospital up to the exit of Indonesian Army Mechanized Infantry 202, with a length of ± 20 m.	No U-turn sign installation	These complex movements at uncontrolled median openings increases the risk of collision posing a threat to the safety of both approaching through and U-turning vehicles. It is attributed to high speed of approaching through vehicles having a possible conflict with the U-turning vehicles (Malaya Mohanty, 2020)
2	There are no sidewalks in either direction.	Construction of good and comprehensive sidewalks in the area of roads and providing pedestrian paths for people with disabilities.	Pedestrian crash along roadways with no sidewalk is 1.67 times greater than the likelihood of a crash with the presence of a sidewalk (Hatem Abou-Senna, 2022)
3	There is a shortage of signs, and the placement of signs is not in accordance with the laws and regulations	Maintenance and installation of signs as well as structuring the location of signs so that they can be seen clearly by vehicle drivers.	Traffic signs and markings serve as control devices that enhance safety and orderly movement of traffic on the roads (Ahmadian et al., 2014). These signs and road markings communicate vital information such

No	Identification of Possible Causes of Accident	Recommendation	Reference
			as warnings, guidelines, and directions to drivers and road users. The messages are conveyed in terms of words and/or symbols and markings (Hashim Al-Madani, 2002).
4	Markings are in good condition, boken and solidlines in both directions are faded	Repainting solid or broken markings so they can be seen clearly.	Traffic signs and markings serve as control devices that enhance safety and orderly movement of traffic on the roads (Ahmadian, 2014).
5	Faded of marked crosswalk	Remarking crosswalk	Behavior of drivers in marked crossing areas is better than in the unmarked crossing area, leading to safer crossing for pedestrians (Abbas Sheykhfar, 2020)

Source: *Analysis*

The table shows several proposed treatments in the form of installing road signs and maintaining road markings at the accident site which can be seen more clearly in Figure 3 below.

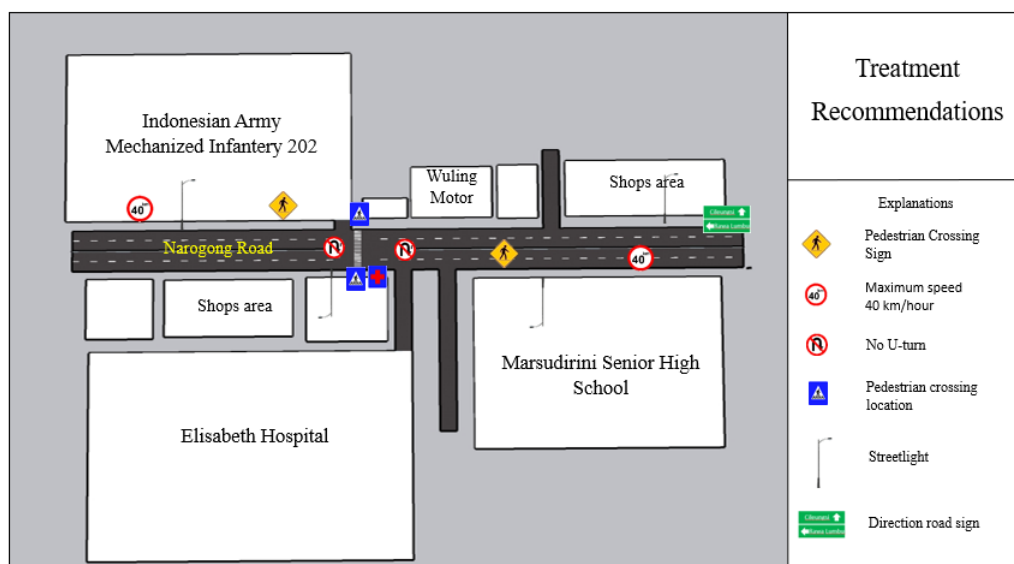





Fig.3Treatment Recommendations on Narogong Road (In front of Elisabeth Hospital, Bekasi)

Figure 3 shows that the recommended treatment is addition of traffic signs with the aim of facilitating road users in understanding conditions, prohibitions, and order on the road. Details of the proposed traffic signs can be seen in Table 2.

Table 2 Number of required traffic signs

Number	Traffic Signs	Symbol	Total
1	Pedestrian Crossing Sign		1

2	Maximum speed 40 km/hour		2
3	Pedestrian crossing location		2
4	No U-turn		2
Total			7

VI. ANALYSIS

Data which used in alaysis process consist of 10 accident data are converted into monetary values IDR to calculate the total costs incurred due to accidents as shown in the table 3

Table3 Accident Cost Calculation on Grid 1205

Num of accidents	Date	Time	Fatality of victim			Accident cost (IDR)
			D	SI	MI	
243	02/02/2020	15:30	0	0	1	1,904,313
145	06/02/2019	05:30	1	0	0	263,02,681
795	04/06/2020	04:50	1	0	0	263,025,681
868	21/06/2021	21:00	0	1	0	12,066,000
1040	28/08/2021	21:00	0	0	1	1,904,313
1062	31/08/2021	18:55	1	0	0	263,025,681
1068	23/08/2021	06:30	0	0	1	1,904,313
1123	10/09/2021	19:00	1	0	0	263,025,681
1161	16/09/2021	21:00	0	0	1	1,904,313
849	15/06/2021	17:30	0	1	0	12,066,000
Total						1,083,851,976

Source: Analysis

Table 3 shows the total cost of losses due to accidents that occurred on Narogong Road in 2019-2021 amounting to IDR 1,083,851,976. This nominal obtained by calculating the value of the victim based on research by GitoSugiiyanto, 2017 that multiplied by the number of victims recorded at the IRSMS Polri.

Each type of treatment provided has a different impact on accident reduction rates. The following is the result of calculating the accident cost savings and Benefit Cost Ratio (BCR) against the handling costs incurredon Technical Guide 1 Road Safety Engineering, Ministry of Public Works, Directorate General of Highways.

Table4 Rate of Reduction After Recommendation (Benefit)

Recommendations	Number of accidents	Reduction rate	Accident cost (IDR)	Cost Reduction (IDR)
Traffic Signs	243, 145, 795, 868, 1040, 1062, 1068, 1123, 1161, 849	30%	1,083,851,976	325,155,593
Road marking	145, 868, 1040, 1068,	10%	292,870,620	29,287,062

	1161, 849			
Marked Crosswalks	243, 1068	30%	3,808,626	1,142,588
Sidewalk development	243, 1068	30%	3,808,626	1,142,588
Total Benefit				356,727,830

Source: Analysis

Based on the Regulation of the Minister of Transportation of the Republic of Indonesia Number: PM 78 of 2014 concerning Cost Standards in the Ministry of Transportation, the authors calculated the costs needed to handle blackspot locations. The results of these calculations can be seen in Table 5.

Table 5 Total Cost Required To Do Recommendation

Recommendations	Number	Unit	Unit Cost (IDR)	Expensive Index	Unit Cost (IDR)	Total Cost (IDR)
Pedestrian Crossing Sign	1	Pcs	1,487,868	1.0055	1,496,051	1,496,051
Maximum Speed 40 km/hour	2	Pcs	1,487,868		1,496,051	2,992,103
No U-turn	2	Pcs	1,487,868		1,496,051	2,992,103
Pedestrian Crossing Location	2	Pcs	1,487,868		1,496,051	2,992,103
Broken Line	31	m'	35,062		35,255	1,092,900
Solid Line	200	m'	35,062		35,255	7,050,968
Marked Crosswalks	58	m'	35,062		35,255	2,044,781
Sidewalk	200	m'	1,500,000		1,508,250	301,650,000
Total Cost						322,311,008

Source: Analysis

Based on the Regulation of the Minister of Transportation of the Republic of Indonesia Number: PM 78 of 2014 concerning Cost Standards at the Ministry of Transportation, a calculation of the costs required for handling at blackspot locations carried out.

$$BCR = \frac{\text{Total Benefit}}{\text{Total Cost}} = \frac{356,727,830}{322,311,008} = 1.1$$

Based on the calculation above, the BCR value is 1.1. Such as previously stated if the value of $BCR > 1$, it is feasible to do treatment. It also can be interpreting that this treatment proposal has a greater advantage than the total costs for the treatment.

greater benefits when compared to the treatment costs incurred.

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Based on the results of observations and processing of blackspot data that have been identified at NarogongRoad, it can be concluded as follows:

- NarogongRoad is a blackspot location in Bekasi City with 10 accidents that resulted in 4 deaths, 2 serious injuries, and 4 minor injuries.
- The recommended treatment is the installation and maintenance of signs, the repair of disabled-friendly pedestrian facilities, repainting the marked crosswalk, construction, and maintenance of sidewalks.
- The treatment recommendations given resulted in a BCR value of 1.1, in other words, these recommendations were declared feasible and could provide

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