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Pharmaceutical Sciences Asia Pharm Sci Asia 2021; 48 (2), 194-202 DOI:https://doi.org/10.29090/psa.2021.02.19.034 Original Article Unit Cost Analysis of Medical Service in Asia: A Systematic Review Ragil Setia Dianingati1, Arthorn Riewpaiboon2* 1 Pharmacy Study Program, Faculty of Medicine, Diponegoro University, Semarang, Indonesia 2 Social, Economic, and Administrative Program, Faculty of Pharmacy, Mahidol University, Bangkok, Thailand *Corresponding author: Arthorn Riewpaiboon arthorn.rie@mahidol.ac.th KEYWORDS: unit cost of medical service, costing method, Asia https://www.pharmacy.mahidol.ac.th/journal/ © Faculty of Pharmacy, Mahidol University (Thailand) 2020 ABSTRACT Nowadays, WHO encourages all nations to employ universal health coverage (UHC). In order to achieve this goal, many things should be considered, since healthcare financing methods and efficiency management are pivotal. The reimbursement rate setting is essential for this matter since it should cover the healthcare cost of beneficial package under the UHC. For the providers (hospitals), financial sustainability depends on a balance of income/ revenue and expenditure/cost, since income is based on budgeting/ financing system, if it is performance-based system. Cost per performance or unit cost is a principal for estimating the budget or payment in case of fee-for-service. This study aimed to explore situation and methodologies of cost analysis of hospital medical services in Asia. This study was designed as a systematic review following the PRISMA guidelines covering research reports during 1997-2016 in the PubMed database. Based on the selection criteria, from 426 records, 18 articles were included to this study, 7 articles were excluded because they were published before 1997. The number and quality of the unit of medical service cost analysis in Asia are not as high as expected. The scope of the research that affects the choice of the costing methodology, such as objective, type of cost, perspective, and provider type, could not be found in some articles. While the common used costing methodology is micro costing or activity based costing (ABC), some studies proposed other approaches that need to be developed to find out a better costing methodology. 1. INTRODUCTION Nowadays, all nations are encouraged to employ universal health coverage (UHC). For achieving this goal, healthcare financing methods and efficiency management are pivotal. The reimbursement rate setting is very important for this matter since it should cover the healthcare cost of beneficial package under the UHC. For the providers (hospitals), financial sustainability depends on a balance of income/ revenue and expenditure/cost, since income is based on budgeting/ financing system, if it is performance-based system. Cost per performance or unit cost is important for estimating the budget or payment in case of fee-for-service. In addition, based on limited income, hospital management on efficiency of services provided is a pivotal part. Cost analysis particularly unit cost estimation is a basic information to explore efficiency, then, cost containment. In this regards, hospital cost analysis to explore unit cost of medical service is required to provide important inputs for appropriate system management. To have high benefit of research utilization, the study results must be valid and reliable. So the review is aimed to explore the quality of the papers and costing methodology that had been used in doing hospital cost analysis in Asia. The review is focused in Asia due to the applicability of costing studies should be among similar health systems or context. 2. MATERIALS AND METHODS 2.1 Data collection method Data was collected during January-June

2018 from PubMed database. 2.2 Study design This study was conducted as a systematic review following the PRISMA guidelines to ex- plore the study and the review focused on the unit cost analysis of medical service in Asia. 2.3 Searching strategy This systematic review had been con- ducted by searching articles that published in PubMed database. PubMed database provides Mesh term of Asia that facilitates searching. PubMed allows doing a broad search in term of Asia countries using. Search terms in this review were (((((hospital*[Title]) OR service*[Title])) AND cost*[Title])) AND Asia [Mesh Terms]. The selection of eligible articles was performed on the basis of the following criteria: the articles must be primary study about unit cost of medical service in Asia that written in English and published in the past 10 years (during 1 Jan 1997 - 31 Dec 2016). 2.4 Analysis The eligible titles and abstracts were screened to determine which articles would be in- cluded for the final review. And then they were re- viewed according to the full text and excluded or included records using the selection criteria. The quality criteria used in this study was a modified checklist of costing methodology derived from a study in development of quality indicators in Thailand1. There were 9 items of quality check- list used in this systematic review from originally 18 items, and 5 items amongst them were the minimum requirement of costing methodology, starting from objectives, perspective, time hori- zon, measurement method, and the type of cost. Since some of the criteria, for instance perspec- tive, population characteristics, selection of tar- get population, and sample size calculation, were likely not to be mentioned, so we excluded them (Table 1). And the checklist is defined as stated or not stated, not quantified. Qualify articles are required to have complete presentation. And de- scriptive statistics was applied to summary the results of analysis as the following topics: • Trend and quality of the studies • Scope of the studies Costing methodologies Table 1. Quality checklist that modified from Kantha (1) Quality indicators Description 1. Was the purpose or the objective of the study clearly stated To check whether the objective of the study has been clearly stated or not 2. Did this study clearly state that it had been analyzed by financial or economic cost approach? To check if the study clearly stated whether they used financial or economic approach 3. Did this study have a time horizon of cost analysis? To check whether the time horizon of the study has been clearly stated or not 195 R.S. Dianingati et al. Pharm Sci Asia 2021; 48 (2), 194-202 Table 1. Quality checklist that modified from Kantha (1) (Cont.) Quality indicators Description 4. Has a unit cost analysis method of this study been stated? To check whether the unit cost analysis method of the study has been clearly stated or not (can be average, micro-costing, RVU, or RCC). 5. Did this study mention indirect cost alloca- tion method? The indirect cost allocation method can be direct method, step-down method, double distribution method, and simultaneous method. 6. Was this study stated the year of the cost value? Year of cost value means what year cost had been analyzed 7. Was the capital cost calculated based on economic-base approach? If the study did not use economic approach, the checklist is applied only until number 6, but if they did, continue to number 8 and 9. 8. Did the authors specify the discount rate used in capital cost calculation? If the answer of question no 7 is yes, they should state that they used discounting rate for the cal- culation. 9. Did this study mention about sensitivity analysis? If the answer of question no 7 is yes, sensitivity analysis should be stated. 3. RESULTS were obtained. Based on screening of the title and abstract, 281 articles were excluded regarding the 3.1. Trend and quality of the unit of medical selection criteria. Then,

51 articles were screened on service costing studies in Asia the full articles. Finally 18 articles were included From the searching results, 426 records in this systematic review (Figure 1). Figure 1. Article selection flowchart 196 Pharmaceutical Sciences Asia There were only a few articles about unit of medical service cost analysis studies in Asia. Palestine and Japan got the highest number of articles, with three articles, Thailand, and Vietnam got the second place with 2 articles. Only three articles could fulfill all of the criteria from the checklist (16,67%), while 15 papers (83,33%) were failed due to lack of information about currency and price data, year of cost values, time horizon, sensitivity analysis and discount rate (in capital cost calculation) of their study (Table 2). Discount rate was used but not mentioned clearly how many percent for the calculation. As consideration, not all of the papers should mention the discount rate, only paper that used economic approach for the capital cost (building and equipment or expenditures), which was beyond the current accounting period into the calculation, needs to use discount rate 2,8. Table 2. Quality check using the modified checklist 1 2 3 4 5 6 7 8 9 No Country Year Using Objec- economic or financial approach tive Time horizon Unit cost analysis method Indirect cost allocation method Year of cost value Included capital cost in economic approach Discount rate Sensitivity analysis Quality based on checklist Ref 1 India 2005 1 2 2 1 1 1 1 1 2 not complete (11) 2 India 2013 1 1 1 1 1 1 1 1 1 complete (6) 3 Iran 2015 1 2 2 1 1 2 1 1 2 not complete (12) 4 Japan 2006 1 2 2 1 2 2 2 - - not complete (4) 5 Japan 2006 1 2 2 1 2 2 2 - - not complete (5) 6 Japan 2009 1 2 1 1 1 1 1 1 2 not complete (13) 7 Malaysia 2004 1 2 1 1 1 1 1 1 1 not complete (7) 8 Nepal 1998 1 1 1 1 1 1 1 1 2 not complete (14) 9 Pakistan 2014 1 1 1 1 2 2 2 - - not complete (15) 10 Palestine 2010 1 2 1 1 1 1 1 1 2 not complete (16) 11 Palestine 2011 1 2 2 1 1 2 2 - - not complete (17) 12 Palestine 2013 1 2 1 1 1 1 1 1 1 not complete (18) 13 Thailand 2007 1 1 1 1 1 1 1 1 1 complete (3) 14 Thailand 2009 1 2 1 1 1 2 1 1 2 not complete (9) 15 Thailand 2011 1 1 1 1 1 1 1 1 1 complete (8) 16 Turkey 2009 1 2 2 1 1 1 1 1 2 not complete (10) 17 Vietnam 2004 1 2 2 1 1 1 1 1 2 not complete (19) 18 Vietnam 2010 1 2 2 1 1 1 1 1 2 not complete (20) Footnotes: 1 : stated clearly 2 : not stated 3.2. Scope of the unit cost analysis of medical provider type, cost items exclusion and rationale service studies in Asia of exclusion. Some articles aimed to explore or In this systematic review, we assessed the to compare the existing costing method with a proposed costing method, while others aimed to study design of the unit of medical service costing implement the standard costing method in their studies in Asia. The study design was defined as country or to manage their institution or organization objective, cost products, type of cost, perspective, more properly. For the cost products, some of the 197 R.S. Dianingati et al. Pharm Sci Asia 2021; 48 (2), 194-202 articles used all (OPD, IPD, and medical services) while the other used only IPD and/or medical services, and some just the lab test. Not all the final reviewed papers used economic approach to calculate the cost, some of them still used financial approach, but some of them did not state clearly whether they used financial or economic approach even they stated that they used the discounting rate for the capital cost. And many articles did not mention their perspective. All of the final reviewed papers used hospital as the provider but some of the studies did not clearly mention the level of service, ownership status and size of the hospital. Some of the articles used different types of hospitals, while others used only public-government funded hospitals. Most of the articles excluded land item into their calculation and some of the articles

that aimed to propose a new costing method only used material item. 3.3. Costing methodology that had been used in the studies of the unit cost analysis of medical service in Asia Knowing how unit of medical service cost analysis study had been implemented in other countries is an important thing especially for other countries that are trying to develop their standards of unit cost of medical service. In the cost center classification, many papers did not mention their cost centers, even they stated that they divided into some cost centers and distributed the cost into absorbing and transient cost centers. For the direct cost calculation, majority of the papers used building, equipment, and vehicles as their capital cost, and also used labor and material cost. Many papers did not include the land oppor- tunity cost. And most of the papers did not mention their indirect cost component, in Khrisnan, 2005, they used 18% allocation of all ward admission to be allocated to the indirect cost since they only used the eye department which consumed 18% of all ward cost. And in Riewpaiboon, 2011, they used 20% of direct cost to be indirect cost since they used the Thailand MoH guideline to do unit cost analysis of medical service. Direct cost determination was used to explore type of cost for the capital cost which lead the usage of discounting rate, useful year, year of cost value and sensitivity analysis. Some articles clearly mentioned that they used economic approach and mentioned the discounting rate, useful year, and year of cost value. Only three papers were found to use the sensitivity analysis, using 5% in Loo, et al (2004), 6% in Riewpaiboon, et al (2007), but in Riewpaiboon, et al (2011) used 4.4 and 2.3 Thailand baht per minute for the salary of the pharmacists and pharmacist assistant because they wanted to explore the effect of labor cost in pharmaceutical services. For the indirect cost allocation method, we found there were 3 methods (Table 3). The most popular method was step-down allocation, since some papers used the average costing method for the calculation. Some of the articles in this systematic review used more than one costing methodology due to their objective. In the other hand, there were two papers that proposed new costing method called simplified activity-based costing (S-ABC) method. Table 3. The amount of articles based on indirect allocation method and unit cost of medical service method Indirect allocation Number of Unit cost of service Number or method articles calculation method articles Direct 5 Average 7 Step-down 7 Micro-costing 9 Simultaneous 2 Micro-costing and average 1 NA 4 Micro-costing, RVU, RCC 1 Total 18 Total 18 Footnote: NA=Not available 4. DISCUSSION From the results of this systematic review, some information about how previous costing studies had been conducted in Asia could be determined. 4.1. Quality of the review This systematic review could not provide the real picture in costing analysis studies in Asia due to some limitations. Some papers might be missing since this systematic review only used PubMed database, since its feature allowed us to do the broad search and specific term in the same time. We did not use grey papers, national published journal or journal that had not been published not in English. Many articles were excluded since they belonged to cost of illness studies. 4.2. Trend and quality of the unit cost analysis of medical service studies in Asia The number and the quality of published papers in unit cost analysis of medical service in Asia were not high. It might be due to the journal limitation, since for the developed countries hospital costing was not a new thing and they just accept paper in hospital costing that explores new method or uses various methods to compare and give new perspective in hospital costing, while in low and middle income countries still need the hospital

costing development. Another factor that might affect was the availability of the researcher or institution that keen on costing analysis. There are only some countries in Asia that have health technology assessment program and university that has special program in social and economic pharmacy or health economics. Therefore, the articles that failed to fulfill the criteria used in this systematic review did not mean that the studies were not good. Some of the articles did not clearly mention some of the criteria because their objective was to develop or propose a new method in costing analysis, or for the discount rate criteria, since there were three papers6,7,12 that does not need to use the discount rate since they excluded building, equipment, vehicle or any expenditure that had useful life. 4.3. Study design of the unit cost analysis of medical service costing studies in Asia The study design of the costing studies is an important thing since it would refer to what would be included or excluded on the documentation of the study2. The objective of each articles leads into different methodology, cost products might be various and other scopes as well. The objective of the reviewed studies is mainly to estimate the cost of medical service in their institution/organization to develop a better financial management, but in some articles they aimed to compare between two or three methods of unit cost of medical service or to develop a simplified costing method. The perspective is the point of view of costing studies from which cost is estimated2 and will determine the cost items that will be included into the costing studies. Ten articles did not explicitly state their perspectives; perhaps it is related to the unit cost analysis of medical service that normally supposed to be provider perspective. Type of cost is an approach used in the study to count the amount of resources that had been used to produce the services. The type of cost also could lead to other parameters such as scope of cost, the usage of discounted value, and sensitivity analysis. There were three articles that did not state it, may be because the author did not think it was important, since they used other parameters that could lead to which type of cost. Furthermore, type of cost could lead to different result. The financial or accounting based approach is ignored the opportunity cost and costs in time difference, which could distort from the reality and made the provider lost such amount of money every year. As found in a study in Thailand by Riewpaiboon3, they compared the calculation by financial and economic-based approach and they found that there was 13% difference. The cost analysis study should state their type of provider or health facilities that they assessed because different type of provider might have dif- ferent way to handle. All of the final reviewed ar- ticles did the unit of medical service cost analysis in hospital. But some of the articles did not mention their provider type explicitly, because they only used a part of departments in a hospital in order to simplify the calculation, since they aimed to develop and propose a new method of cost analysis. In the other hand, some studies used more than one in order to inform a per capita payment system that will be paid through the same payment system2 or included in the universal health coverage system. Cost item is cost that included in the calculation of unit of medical service cost analysis and it depends on the perspective and type of cost of the studies. Many studies that included in this systematic review did not include the opportunity cost of the land used since it was difficult to obtain the data or not relevant to the study objective. And some studies that aimed to develop new method in costing analysis just used the material cost item in their calculation to simplify and to observe the way to allocate the direct to

indirect cost was correct or not as in two papers by Cao et al in 2006. 4.4. Costing methodology that had been used in the costing studies of the unit of medical service in Asia There are some costing methodologies that can be applied to do unit of medical service analysis, and it depends on the objective of the study (Figure 2). For the cost center classification criteria, some papers did not mention clearly their absorbing and transient cost center even they said that they divided into those groups. It might be caused by the limitation of the journal itself for the amount of words or pages, or because they did not think that it was important to do. There are two papers that only used material cost since they only picked one department and did the simulation because their objective is to develop a method4,5. Many papers only stated they used all the cost that could not assign directly to the patient as the indirect cost, it may be because they had an enormous data from the hospitals and it would be very long if they mentioned all. And some papers used the percentage estimation of the direct cost to be allocated as indirect cost due to their government guideline or due to the proportion of the ward that they used as an object. Figure 2. Common approach used costing methodology in unit cost analysis of medical service OP : Outpatient IP : Inpatient The type of cost will determine the study whether they would use the discounting rate or not. Articles that clearly mentioned that they used the economic approach did use the discounting rate, mainly 3%. But some that only used the fi- nancial approach; perhaps they did not want to use the data for further analysis. And some papers used the discounting rate but they did not mention clearly the approach. It could be happened since the researchers did not think it was important to 200 Pharmaceutical Sciences Asia state it explicitly. Only four papers used the sensi- tivity analysis to explore the changes of the cost, due to the guideline that they adopted3,6-8. For the indirect cost allocation method, the most popular is the step-down approach, especially for the paper that used the standard/ average costing method for the unit cost of medical service calculation, since it is easier than the simultaneous but more accurate than the direct allocation method9. The newest method nowadays for the unit cost analysis of medical service is activity- based costing. It can provide accurate results and determine not only the cost but also the process or the performances since it is based on the activity of each cost object10. It is undeniable that ABC method requires many data and uses many cost drivers, which are sometimes very difficult to be obtained especially in the low-middle income countries. A new method is proposed by Cao et al4,5, is called simplified activity-based costing or cost driver reduction (CDR). This method is aimed to simplify the ABC method by reducing the cost drivers; it objectively selects the representative cost drivers from many cost drivers, which have a high correlation among others. This method is as accurate as the ABC method and simpler since it uses selected cost drivers. However it needs many studies to establish since it was just applied in the three kinds of laboratory test in a hospital in Japan for the simulation. In summary, average method is more practical since it does not need much cost driver and it is able to represent the actual cost, although it is not as accurate as micro-costing (ABC). For ABC method, it is more accurate than other approaches3, yet it needs many cost drivers, more time and cost consuming to do it4,5. Other approaches are RVU and RCC, in which RVU focuses in each production or department3, while RCC can reveal the difference of the existing price with the real costs3. However RVU needs the micro-costing results and standard RVU should be developed first; while RCC method needs price adjustment3. 5.

CONCLUSIONS The number and quality of the unit of medical service cost analysis in Asia are not as high as expected. Most of the papers (83,33%) was failed to complete the checklist criteria. The main methodology used was a micro-costing approach which employed many data but given more accurate results. Some studies propose other approaches that need to be developed and tested to find out a better costing methodology. 6. ACKNOWLEDGEMENTS There is not any conflict of interest in this study. This study has been done by supports from LPDP (Indonesia Endowment Fund) Scholarship, without any interference from the funder. Conflict of interest There is not any conflict of interest on this study. Funding None to declare Ethical approval None to declare Article info: Received May 7, 2019 Received in revised form March 23, 2020 Accepted March 30, 2020 REFERENCES 1. Kantha S. Development of Quality Indicators for Assessment of Costing Studies in Thailand. Bangkok: Mahidol University; 2009. 2. Ožaltın A, and C. Cashin. Costing of Health Services for Provider Payment: A Practical Manual Based on Country Costing Challenges, Trade-offs and Solutions: Joint Learning Network for Universal Health Coverage; 2014. 3. Riewpaiboon A, Malaroje S, Kongsawatt S. Effect of costing methods on unit cost of hospital medical services. Tropical medicine & international health : TM & IH. 2007;12(4): 554-63. 4. Cao P, Toyabe S, Akazawa K. Development of a practical costing method for hospitals. The Tohoku journal of experimental medicine. 2006;208(3):213-24. 5. Cao P, Toyabe S, Kurashima S, Okada M, Akazawa K. A modified method of activity- based costing for objectively reducing cost drivers in hospitals. Methods of information in medicine. 2006;45(4):462-9. Table 1. Quality checklist that modified from Kantha (1) (Cont.) Quality indicators Description 4. Has a unit cost analysis method of this study been stated? To check whether the unit cost analysis method of the study has been clearly stated or not (can be average, micro-costing, RVU, or RCC). 5. Did this study mention indirect cost alloca- tion method? The indirect cost allocation method can be direct method, step-down method, double distribution method, and simultaneous method. 6. Was this study stated the year of the cost value? Year of cost value means what year cost had been analyzed 7. Was the capital cost calculated based on economic-base approach? If the study did not use economic approach, the checklist is applied only until number 6, but if they did, continue to number 8 and 9 . 8. Did the authors specify the discount rate used in capital cost calculation? If the answer of question no 7 is yes, they should state that they used discounting rate for the cal- culation. 9. Did this study mention about sensitivity analysis? If the answer of question no 7 is yes, sensitivity analysis should be stated. 3. RESULTS were obtained. Based on screening of the title and abstract, 281 articles were excluded regarding the 3.1. Trend and quality of the unit of medical selection criteria. Then, 51 articles were screened on service costing studies in Asia the full articles. Finally 18 articles were included From the searching results, 426 records in this systematic review (Figure 1). Figure 1. Article selection flowchart There were only a few articles about unit of medical service cost analysis studies in Asia. Palestine and Japan got the highest number of articles, with three articles, Thailand, and Vietnam got the second place with 2 articles. Only three articles could fulfill all of the criteria from the checklist (16,67%), while 15 papers (83,33%) were failed due to lack of information about currency and price data, year of cost values, time horizon, sensitivity analysis and discount rate (in capital cost calculation) of their study (Table 2). Discount rate was used but not

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 articles used all (OPD, IPD, and medical services) while the other used only IPD and/or medical services, and some just the lab test. Not all the final reviewed papers used economic approach to calculate the cost, some of them still used financial approach, but some of them did not state clearly whether they used financial or economic approach even they stated that they used the discounting rate for the capital cost. And many articles did not mention their perspective. All of the final reviewed papers used hospital as the provider but some of the studies did not clearly mention the level of service, ownership status and size of the hospital. Some of the articles used different types of hospitals, while others used only public-government funded hospitals. Most of the articles excluded land item into their calculation and some of the articles that aimed to propose a new costing method only used material item. 3.3. Costing methodology that had been used in the studies of the unit cost analysis of medical service in Asia Knowing how unit of medical service cost analysis study had been implemented in other countries is an important thing especially for other countries that are trying to develop their standards of unit cost of medical service. In the cost center classification, many papers did not mention their cost centers, even they stated that they divided into some cost centers and distributed the cost into absorbing and transient cost centers. For the direct cost calculation, majority of the papers used building, equipment, and vehicles as their capital cost, and also used labor and material cost. Many papers did not include the land oppor- tunity cost. And most of

the papers did not mention their indirect cost component, in Khrisnan, 2005, they used 18% allocation of all ward admission to be allocated to the indirect cost since they only used the eye department which consumed 18% of all ward cost. And in Riewpaiboon, 2011, they used 20% of direct cost to be indirect cost since they used the Thailand MoH guideline to do unit cost analysis of medical service. Direct cost determination was used to explore type of cost for the capital cost which lead the usage of discounting rate, useful year, year of cost value and sensitivity analysis. Some articles clearly mentioned that they used economic approach and mentioned the discounting rate, useful year, and year of cost value. Only three papers were found to use the sensitivity analysis, using 5% in Loo, et al (2004), 6% in Riewpaiboon, et al (2007), but in Riewpaiboon, et al (2011) used 4.4 and 2.3 Thailand baht per minute for the salary of the pharmacists and pharmacist assistant because they wanted to explore the effect of labor cost in pharmaceutical services. For the indirect cost allocation method, we found there were 3 methods (Table 3). The most popular method was step-down allocation, since some papers used the average costing method for the calculation. Some of the articles in this systematic review used more than one costing methodology due to their objective. In the other hand, there were two papers that proposed new costing method called simplified activity-based costing (S-ABC) method. Table 3. The amount of articles based on indirect allocation method and unit cost of medical service method Indirect allocation Number of Unit cost of service Number or method articles calculation method articles Direct 5 Average 7 Step-down 7 Micro-costing 9 Simultaneous 2 Micro-costing and average 1 NA 4 Micro-costing, RVU, RCC 1 Total 18 Total 18 Footnote: NA=Not available 198 Pharmaceutical Sciences Asia 4. DISCUSSION From the results of this systematic review, some information about how previous costing studies had been conducted in Asia could be determined. 4.1. Quality of the review This systematic review could not provide the real picture in costing analysis studies in Asia due to some limitations. Some papers might be missing since this systematic review only used PubMed database, since its feature allowed us to do the broad search and specific term in the same time. We did not use grey papers, national published journal or journal that had not been published not in English. Many articles were excluded since they belonged to cost of illness studies. 4.2. Trend and quality of the unit cost analysis of medical service studies in Asia The number and the quality of published papers in unit cost analysis of medical service in Asia were not high. It might be due to the journal limitation, since for the developed countries hospital costing was not a new thing and they just accept paper in hospital costing that explores new method or uses various methods to compare and give new perspective in hospital costing, while in low and middle income countries still need the hospital costing development. Another factor that might affect was the availability of the researcher or institution that keen on costing analysis. There are only some countries in Asia that have health technology assessment program and university that has special program in social and economic pharmacy or health economics. Therefore, the articles that failed to fulfill the criteria used in this systematic review did not mean that the studies were not good. Some of the articles did not clearly mention some of the criteria because their objective was to develop or propose a new method in costing analysis, or for the discount rate criteria, since there were three papers6,7,12 that does not need to use the discount rate since they excluded building, equipment, vehicle or any expenditure that had useful life. 4.3. Study design of the

unit cost analysis of medical service costing studies in Asia The study design of the costing studies is an important thing since it would refer to what would be included or excluded on the documentation of the study2. The objective of each articles leads into different methodology, cost products might be various and other scopes as well. The objective of the reviewed studies is mainly to estimate the cost of medical service in their institution/organization to develop a better financial management, but in some articles they aimed to compare between two or three methods of unit cost of medical service or to develop a simplified costing method. The perspective is the point of view of costing studies from which cost is estimated2 and will determine the cost items that will be included into the costing studies. Ten articles did not explicitly state their perspectives; perhaps it is related to the unit cost analysis of medical service that normally supposed to be provider perspective. Type of cost is an approach used in the study to count the amount of resources that had been used to produce the services. The type of cost also could lead to other parameters such as scope of cost, the usage of discounted value, and sensitivity analysis. There were three articles that did not state it, may be because the author did not think it was important, since they used other parameters that could lead to which type of cost. Furthermore, type of cost could lead to different result. The financial or accounting based approach is ignored the opportunity cost and costs in time difference, which could distort from the reality and made the provider lost such amount of money every year. As found in a study in Thailand by Riewpaiboon3, they compared the calculation by financial and economic-based approach and they found that there was 13% difference. The cost analysis study should state their type of provider or health facilities that they assessed because different type of provider might have dif- ferent way to handle. All of the final reviewed ar- ticles did the unit of medical service cost analysis in hospital. But some of the articles did not mention their provider type explicitly, because they only used a part of departments in a hospital in order to simplify the calculation, since they aimed to develop and propose a new method of cost analysis. 199 R.S. Dianingati et al. Pharm Sci Asia 2021; 48 (2), 194-202 In the other hand, some studies used more than one in order to inform a per capita payment system that will be paid through the same payment system2 or included in the universal health coverage system. Cost item is cost that included in the calculation of unit of medical service cost analysis and it depends on the perspective and type of cost of the studies. Many studies that included in this systematic review did not include the opportunity cost of the land used since it was difficult to obtain the data or not relevant to the study objective. And some studies that aimed to develop new method in costing analysis just used the material cost item in their calculation to simplify and to observe the way to allocate the direct to indirect cost was correct or not as in two papers by Cao et al in 2006. 4.4. Costing methodology that had been used in the costing studies of the unit of medical service in Asia There are some costing methodologies that can be applied to do unit of medical service analysis, and it depends on the objective of the study (Figure 2). For the cost center classification criteria, some papers did not mention clearly their absorbing and transient cost center even they said that they divided into those groups. It might be caused by the limitation of the journal itself for the amount of words or pages, or because they did not think that it was important to do. There are two papers that only used material cost since they only picked one department and did the simulation because their objective is to develop a method4,5. Many papers only stated they

used all the cost that could not assign directly to the patient as the indirect cost, it may be because they had an enormous data from the hospitals and it would be very long if they mentioned all. And some papers used the percentage estimation of the direct cost to be allocated as indirect cost due to their government guideline or due to the proportion of the ward that they used as an object. Figure 2. Common approach used costing methodology in unit cost analysis of medical service OP : Outpatient IP : Inpatient The type of cost will determine the study whether they would use the discounting rate or not. Articles that clearly mentioned that they used the economic approach did use the discounting rate, mainly 3%. But some that only used the fi- nancial approach; perhaps they did not want to use the data for further analysis. And some papers used the discounting rate but they did not mention clearly the approach. It could be happened since the researchers did not think it was important to 200 Pharmaceutical Sciences Asia state it explicitly. Only four papers used the sensi- tivity analysis to explore the changes of the cost, due to the guideline that they adopted3,6-8. For the indirect cost allocation method, the most popular is the step-down approach, especially for the paper that used the standard/ average costing method for the unit cost of medical service calculation, since it is easier than the simultaneous but more accurate than the direct allocation method9. The newest method nowadays for the unit cost analysis of medical service is activity- based costing. It can provide accurate results and determine not only the cost but also the process or the performances since it is based on the activity of each cost object10. It is undeniable that ABC method requires many data and uses many cost drivers, which are sometimes very difficult to be obtained especially in the low-middle income countries. A new method is proposed by Cao et al4,5, is called simplified activity-based costing or cost driver reduction (CDR). This method is aimed to simplify the ABC method by reducing the cost drivers; it objectively selects the representative cost drivers from many cost drivers, which have a high correlation among others. This method is as accurate as the ABC method and simpler since it uses selected cost drivers. However it needs many studies to establish since it was just applied in the three kinds of laboratory test in a hospital in Japan for the simulation. In summary, average method is more practical since it does not need much cost driver and it is able to represent the actual cost, although it is not as accurate as micro-costing (ABC). For ABC method, it is more accurate than other approaches3, yet it needs many cost drivers, more time and cost consuming to do it4,5. Other approaches are RVU and RCC, in which RVU focuses in each production or department3, while RCC can reveal the difference of the existing price with the real costs3. However RVU needs the micro-costing results and standard RVU should be developed first; while RCC method needs price adjustment3. 5. CONCLUSIONS The number and quality of the unit of medical service cost analysis in Asia are not as high as expected. Most of the papers (83,33%) was failed to complete the checklist criteria. The main methodology used was a micro-costing approach which employed many data but given more accurate results. Some studies propose other approaches that need to be developed and tested to find out a better costing methodology. 6. ACKNOWLEDGEMENTS There is not any conflict of interest in this study. This study has been done by supports from LPDP (Indonesia Endowment Fund) Scholarship, without any interference from the funder. Conflict of interest There is not any conflict of interest on this study. Funding None to declare Ethical approval None to declare Article info: Received May 7, 2019 Received in revised form

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