

QUATTRI &amp; SMETS

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**37th WEDC International Conference, Hanoi, Vietnam, 2014****SUSTAINABLE WATER AND SANITATION SERVICES  
FOR ALL IN A FAST CHANGING WORLD****Lack of community-level improved sanitation causes  
stunting in rural villages of Lao PDR and Vietnam***M. Quattri & S. Smets, UK***REFEREED PAPER 2040**

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*Increasing evidence indicates that inadequate sanitation is among the underlying causes of stunting. Stunted children are not only shorter than average: their cognitive development and chances to become productive adults are also affected. Poor sanitation, especially open defecation, still prevails in rural communities of Lao PDR, while unimproved sanitation showed no improvement in rural Vietnam during the past decade (although open defecation has declined rapidly). The poorest living in remote villages of Lao PDR and rural mountainous regions of Vietnam suffer the most from unimproved sanitation and stunting. Our analysis shows that community-level unimproved sanitation causes stunting in rural Vietnam and Lao PDR, regardless of whether a child household uses improved toilets. Thus, policies, programmatic interventions and incentives would best focus on community-wide (rather than household) outcomes and behavioural change. Targeted support for the poor might be a complementary element to ensure their inclusion.*

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**Introduction**

One of the underlying causes of undernutrition is unsafe water, inadequate sanitation and poor hygiene (WASH) practices (UNICEF, 1990). Poor WASH practices lead to increased exposure to human feces, which are a primary source of diarrheal pathogens (bacteria, viruses, protozoa) and worms.

When fecal bacteria are ingested in large quantities by young children living in unhygienic conditions they may cause environmental enteropathy (EE). This in turn can cause inadequate absorption of nutrients, leading to children becoming undernourished and stunted [Checkley et al. (2008), Humphrey (2009)].

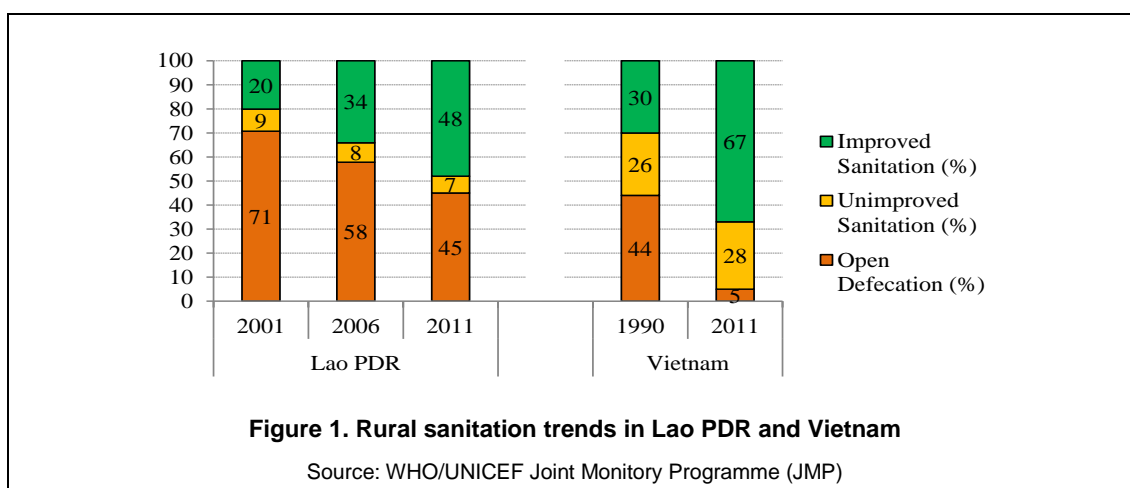
Stunting makes children more vulnerable to diarrhoea, pneumonia, measles and other infectious diseases and more likely to die from them (Black, 2013). Stunted children are also more likely to have poorer cognitive and educational outcomes in later childhood and adolescence (Grantham-McGregor et al., 2007), to become less productive adults (Vogl, 2012) and be less able to then contribute to their nation's growth.

Recognizing that many factors are contributing to stunting, the elimination of open defecation and unimproved sanitation should be a priority issue for policy makers who are concerned with maximizing the potential of the current and future human capital of their countries.

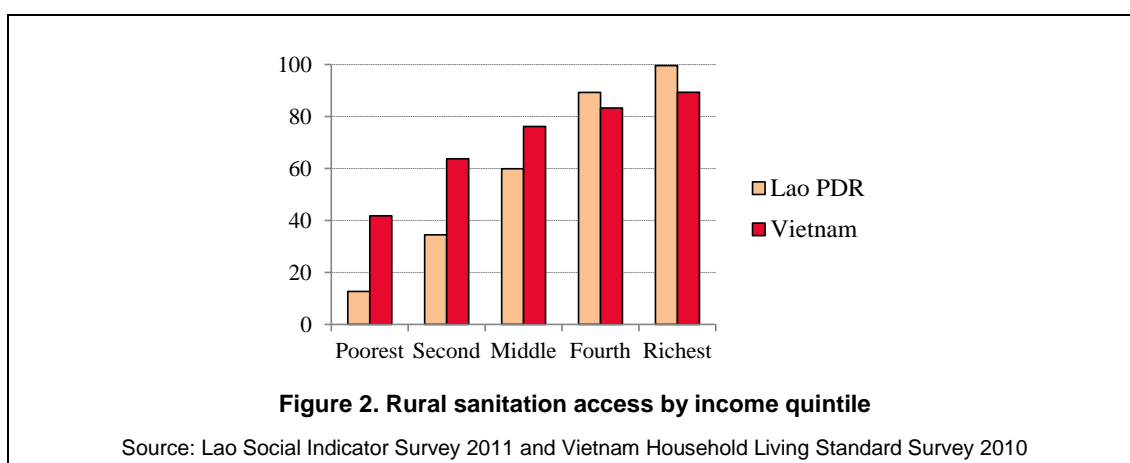
**Sanitation and stunting situation in Lao PDR and Vietnam**

Lao PDR has made good progress in improving sanitation services during the last decade. However, only 48 per cent of the rural population was using improved facilities in 2011 (Figure 1).

In Vietnam, whilst the prevalence of open defecation has dramatically declined between 1990 (44 per cent) and 2011 (5 per cent), the percentage of households using unimproved facilities has stagnated around 27 per cent (Figure 1). Lack of improved sanitation is mainly found in Vietnam's highland regions: the Central Highlands, the Northern Midlands and Mountain Areas and the North Central and Central Coast Area.<sup>1</sup>



The poorest segments of the population living in rural areas suffer the most from the lack of improved sanitation facilities. The rural poorest are 5 times and 8 times more likely, in Vietnam and Laos respectively, to openly defecate or use an unimproved facility than the richest (Figure 2).



Similar patterns are found for stunting prevalence. Children living in rural areas (particularly remote areas without road access) and that were born in households from the poorest income quintile are more at risk of being moderately and severely stunted.<sup>2</sup> In Vietnam, this is especially the case for children who live in mountainous locations.

### Problem statement

Widespread lack of improved sanitation in rural communities of Lao PDR and Vietnam and high levels of stunting make us question whether community-level poor sanitation leads to stunting. If the answer is affirmative, could a family protect her/his child from the risk of stunting by using improved facilities, even when not all households in the community practice improved sanitation? Does community-level poor sanitation make children at risk of stunting anyway?

### Methodology

Stunting depends on socio-economic characteristics of the child's household (that is, average monthly expenditure and ownership of assets, household head's sex and ethnicity and mother's education), child's characteristics (sex and age, month of birth, feeding practices and access to health services) and environmental factors (poor water and sanitation practices, local area population density and access to infrastructure).<sup>3</sup>

We regress the height-for-age Z score for children younger than five on these explanatory variables. Children whose height-for-age is more than two standard deviations below the median of the reference

population are considered short for their age and are classified as moderately or severely stunted (UNICEF, Nutrition).<sup>4</sup>

Our independent variable of interest is community-level open defecation and unimproved sanitation. For Vietnam, we exclude hanging toilets/latrines from the definition of ‘unimproved sanitation’. The reason is that children are less likely to be exposed to fecal contamination from feces from fish-pond latrines, as the feces are ‘water sealed’ and not exposed to flies. Further econometric analysis indicates that the use of hanging toilets by community members has no significant negative impact on stunting.

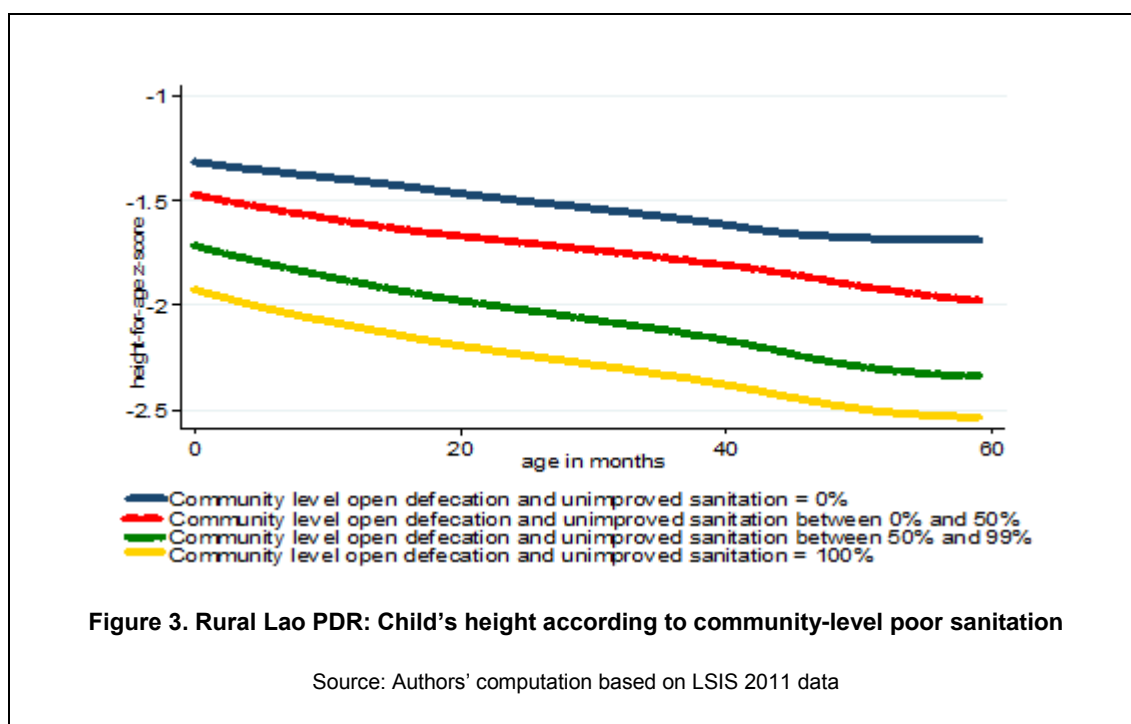
For Lao PDR, we use the Multiple Indicator Cluster Survey 2006 – MICS3, and the Lao Social Indicator Survey – LSIS 2011 database to statistically estimate the impact of lack of community-level sanitation on stunting. The consideration of two years (2006 and 2011) allows us to control for the change in children’s height over time and for systematic differences (for example climate patterns) across the regions of the country.

For Vietnam, we rely on MICS4 2010/11 data and conduct a multiple regression analysis. In the stunting-sanitation analysis for Vietnam, we cannot control for fixed effects because sanitation facilities are not directly comparable across the survey rounds 2000 and 2010/11. MICS2 (2000) data report the category ‘traditional latrines’ that are a mix of improved and unimproved sanitation, and it is not clear whether traditional latrines include hanging toilets. We run the multiple regression estimation for Vietnam for rural areas of all regions of the country and for a subset of regions (the Central Highlands, the Northern Midlands and Mountain Areas and the North Central and Central Coast Area), where unimproved sanitation and stunting prevail. As we obtain similar results, we focus this policy brief on the subset of regions.

For both Vietnam and Lao, the econometric estimations are conducted with cluster-robust standard errors with clustering on villages for Vietnam’s multiple regression and on regions and villages for Lao’s panel estimation.

## Key findings

Figure 3 (for rural Lao PDR) and Figure 4 (for all regions of rural Vietnam) show the correlation between a child’s height and the sanitation status in that child’s locality. As open defecation and unimproved sanitation status moves from 0 per cent of the community to 100 per cent, children are on average shorter than healthy children. Children grow short even when only a small proportion of villagers (less than 50 per cent) do not use improved latrines.



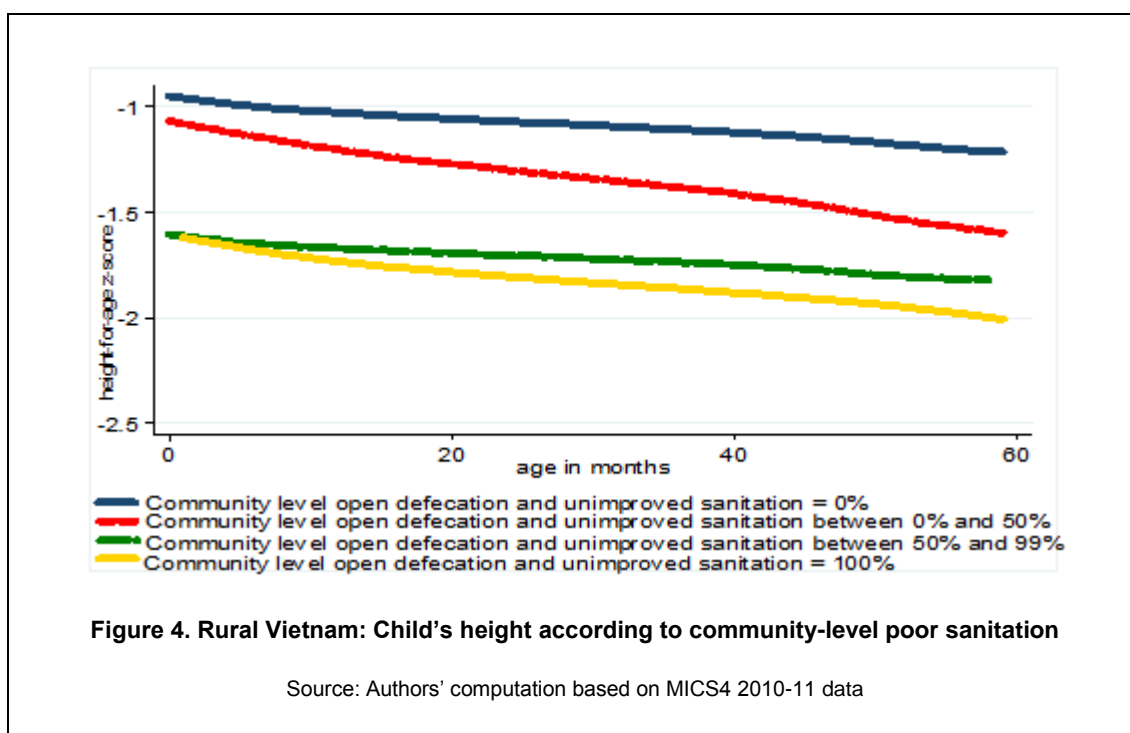


Table 1 presents the results of the panel regression analysis for rural Laos; Table 2 reports the results of the multiple regression estimation for rural Vietnam and for the subset of highland regions.

Summary statistics show that open defecation has been steadily decreasing in rural Vietnam during the last ten years, and it is now around 5 per cent, but the prevalence of unimproved sanitation did not change (see Figure 1). For this reason, we distinguish between community-level open defecation and community-level unimproved sanitation for rural Vietnam. Results indicate that only community-level unimproved sanitation significantly impacts on a child's height.

<b>Table 1. Lao PDR: Panel regression analysis (LSIS, 2011 and MICS 3, 2006) – Selected variables</b>	
The dependent variable is the Height-for-Age Z score for children between 0 and 59 months	
<b>Sanitary means of excreta disposal</b>	
Community level open defecation and unimproved sanitation	-0.226** (0.099)
Child household open defecation and unimproved sanitation	0.026 (0.065)
Observations	5,915
Adjusted R-squared	0.168
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1	

<b>Table 2. Vietnam: Multiple regression results (MICS4, 2010/11) – Selected variables</b>	
The dependent variable is the Height-for-Age Z score for children between 0 and 59 months	
<b>Sanitary means of excreta disposal</b>	
Community level unimproved sanitation	-0.797** (0.354)
Child household unimproved sanitation	-0.163 (0.125)
Observations	1,635
Adjusted R-squared	0.225
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 The results refer to the Central Highlands, the Northern Midlands and Mountain Areas and the North Central and Central Coast Area.	

The econometric estimation indicate that,

- Unimproved sanitation in rural villages leads to shorter children in those villages – The coefficients - 0.226 (for Lao PDR) and -0.797 (for Vietnam) are highly statistically significant, and are found after controlling for other socio-economic, demographic and health variables, environmental factors and for fixed effects (for Lao PDR). These coefficients imply that an average five-year-old child is 1.1 cm (in Lao PDR) and 3.7 cm (in the selected regions of Vietnam) shorter than a child who lives in a rural village where everybody uses improved facilities.
- Neighbours' poor sanitation negatively affects a child's height even when the child's family uses improved facilities – The use of improved sanitation facilities by a child's household has no beneficial impact on that child's height if other households in the rural village practice poor sanitation. In fact, the coefficient for the child's household sanitation practices (0.026 for Lao PDR and -0.163 for Vietnam) is statistically insignificant. Poor sanitation by other community members still brings the disease factor close to the child's home, and the child of a household with improved sanitation remains susceptible of stunting.
- Local area poor sanitation causes children to be shorter than average at every age – Further econometric analysis distinguishes between children in the age group [0, 24] months and children in the age group [25, 59] months. We find that the negative impact of poor sanitation on stunting is statistically significant for both age groups. Thus, community-level poor sanitation has a permanent effect on the height of a child. Similarly, lost cognitive development and learning abilities in the early years are unlikely to be recovered later in life.

## Conclusions and policy recommendations

Lack of community-level improved sanitation causes stunting in rural villages of Lao PDR and Vietnam. Poor sanitation and stunting still prevail particularly among the poorest and remote rural villages. Stunted children are not only shorter than average, but they are also more likely to have poor cognitive abilities and become less productive adults.

Policies and interventions should focus on community-wide behavioural change and outcomes, rather than focus on individual household investment in improved sanitation. Targets and incentives need to align with such collective outcomes. Community-wide targets are not yet used in Vietnam's Third National Target Programme for Rural Water Supply and Sanitation. A programmatic approach that focusses on community-wide behavioural change and sanitation outcomes is still to be adopted in Vietnam, beyond existing small scale interventions.

The Lao PDR's 'Model Healthy Village Programme' sets 'the bar' of improved sanitation at 60 per cent for villages without road access and 70 per cent for villages with road access; though, our analysis suggests that this will not effectively reduce stunting. However, the Lao PDR Government is about to issue a

guideline for Open Defecation Free villages, which is defined by a 100 per cent of households using improved facilities.

To ensure poor-inclusive rural sanitation programmes, targeted support for the poor, such as low-interest household financing and/or targeted output-based payments, might be necessary. Affordable, accessible and aspirational toilets remain needed to move more people from open defecation and unimproved sanitation to improved sanitation, while community mobilization and behavioural change communications are required to support a new social norm within communities.

### Definition of sanitary means of excreta disposal

- Improved sanitation includes water flush latrine (that is, flush to piped sewer system, septic tank, pit latrine or unknown place), pit latrine with a slab and cover, ventilated improved pit (VIP) latrine, composting toilet (and, for rural areas of Vietnam, hanging toilets/latrines);
- Unimproved sanitation is the use of pit latrines without slab/open pit, bucket toilets and toilets that flush to somewhere other than a septic tank or sewer (that is, street, yard or plot, open sewer, a ditch, a drainage way or other location);
- Open defecation is the lack of any facility and/or defecation in the bush, field or forest.

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### References

- Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R. and R. Uauy (2013). *Maternal and child undernutrition and overweight in low-income and middle-income countries*. The Lancet Vol. 382, Issue 9890, pp.427–451.
- Checkley, W., Buckley, G., Gilman, R. H., Assis, A. M., Guerrant, R. L., Morris, S. S., Molbak, K., Valentiner-Branth, P., Lanata, C. F., Black, R. E. and The Childhood Malnutrition and Infection Network (2008) *Multi-country analysis of the effects of diarrhoea on childhood stunting*. International Journal of Epidemiology, Vol. 37, pp. 816–830.
- General Statistics Office (GSO) of Vietnam (2010) *Viet Nam Household Living Standards Survey (VHLSS)*.
- Grantham-McGregor, S., Cheung, Y.B., Cueto, S., Glewwe, P., Richter, L. and B. Strupp (2007) *Developmental potential in the first 5 years for children in developing countries*. The Lancet Vol. 369, Issue 9555, pp. 60–70.
- Humphrey, J. H. (2009) *Child undernutrition, tropical enteropathy, toilets, and hand-washing*. The Lancet, Vol. 374, pp. 1032–35.
- Laos' Ministry of Health (MoH) and Lao Statistics Bureau (LSB) (2012) *Lao PDR, Lao Social Indicator Survey 2011–12 (Multiple Indicator Cluster Survey/Demographic and Health Survey)*.
- United Nations Children's Fund (UNICEF) (1990) *Conceptual Framework*, <http://www.unicef.org/nutrition/training/2.5/4.html> (accessed December 2013).
- UNICEF, *Nutrition – Definition of indicators*; [http://www.unicef.org/infobycountry/stats\\_popup2.html](http://www.unicef.org/infobycountry/stats_popup2.html), accessed February 2014.
- UNICEF (2010-11) *MICS4 – Multiple Indicator Cluster Survey 2010–2011 for Vietnam and MICS3 for Lao People's Democratic Republic*, [http://www.childinfo.org/mics4\\_surveys.html](http://www.childinfo.org/mics4_surveys.html), accessed May 2013.
- Vogl, T. (2012) *Height, Skills, and Labour Market Outcomes in Mexico*. Department of Economics, Princeton University.
- Walker, S.P., Chang, S.M., Powell, C.A., Simonoff, E. and S.M. Grantham-McGregor (2007) *Early childhood stunting is associated with poor psychological functioning in late adolescence and effects are reduced by psychosocial stimulation*. Journal of Nutrition Vol. 137, Issue 11, pp. 2464–69.

World Health Organization (WHO)/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation, [http://www.wssinfo.org/documents-links/documents/?tx\\_displaycontroller%5Btype%5D=country\\_files](http://www.wssinfo.org/documents-links/documents/?tx_displaycontroller%5Btype%5D=country_files), accessed February 2014.

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### Notes

<sup>1</sup> In 2010/11, the rural population without improved sanitation were 31 per cent in the Central Highlands, 24 per cent in the Northern Midlands and Mountain Areas and 18 per cent in the North Central and Central Coast Area (MICS4 2010/11 data). Although 51 per cent of all households in the Mekong River Delta region were using hanging toilets/latrines in 2011 (MICS4 2010/11 data), for the purpose of this analysis we excluded such toilets from the ‘unimproved’ category.

<sup>2</sup> 26.8 per cent of all rural children in Vietnam (as compared with 11 percent of children living in urban areas, UNICEF MICS4) and 48 per cent in Lao PDR (27.4 percent of urban children, LSIS 2011) were stunted in 2010/11. In Laos, the number of stunted children for the poorest income quintile was three times greater than that for the richest income quintile (ibid.). Similar data are not available for Vietnam.

<sup>3</sup> Because of data unavailability, the following variables could not be included in the econometric estimations for Vietnam and Lao PDR: mother’s age, height, BMI, and employment status in the 12 months preceding the survey date, information on whether the child is twin and size of the child at birth, information on whether the child was given iron supplementation, place of delivery, and distance to health facility.

<sup>4</sup> Moderate stunting occurs when height-for-age is between -2 and -3 standard deviations from the reference median; severe stunting prevails when height-for-age is more than three standard deviations below the reference median (UNICEF, Nutrition).

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