



HOME HOSPITALIZATION IN CHILDREN AND YOUTH WITH SPECIAL HEALTH CARE NEEDS (CYSHCN): FINANCIAL PERSPECTIVES IN HOSPITAL DE ALTA COMPLEJIDAD, CHILE

HOSPITALIZACIÓN DOMICILIARIA EN NIÑOS Y ADOLESCENTES CON NECESIDADES ESPECIALES DE ATENCIÓN EN SALUD (CYSHCN): PERSPECTIVAS FINANCIERAS EN HOSPITAL DE ALTA COMPLEJIDAD, CHILE

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ABSTRACT

Introduction: The absence of home hospitalization (HH) of children and youth with special health care needs (CYSHCN) generates prolonged hospitalizations in closed care (CC). **Objective:** To compare the estimated cost of HH of high complexity CYSHCN versus the actual cost of the same patient in CC and its impact on hospital production. **Methods:** Descriptive and comparative study between costs of both hospitalization modalities of high complexity CYSHCN. From January to December 2016, non-oncological CYSHCN hospitalizations were registered by the Pediatric Service (PS) according to the Ministry of Health-Chile (MINSAL) norm. It was classified for clinical groups and similar consumption of resources according to groups related to diagnosis (DRG). The stay was adjusted, and financial analysis of both modalities (CC and HH) was performed to evaluate the impact on hospital production. **Results:** Of 3690 discharges, 126 (3.4%) were related to 27 CYSHCN, the average age was 4.6 years (± 5 SD) with technological dependencies to live. The mean CYSHCN stay was 16 days, compared with 5.9 for patients without special health needs. CYSHCN stays reached 2017 days (8.6%). Disregarding the CYSHCN discharges would have contributed 320 additional discharges, and his HH would have saved US \$ 15 / day per patient, which for the total number of stays consumed would have been an annual saving of US \$ 29170. **Conclusions:** HH has an estimated cost lower than the CA of high complexity CYSHCN, improves hospital productivity, and frees critical beds with financially viable investment.

Key words: Terminal chronic disease; Health care costs; Home Health Care Services; Hospitalization (source: MeSH NLM).

RESUMEN

Introducción: La ausencia de hospitalización domiciliaria (HD) de niños y adolescentes con necesidades especiales en salud de alta complejidad (NANEAS) genera hospitalizaciones prolongadas en la atención cerrada (AC). **Objetivos:** Comparar el gasto estimado de HD de NANEAS de alta complejidad versus costo real del mismo paciente en AC y su impacto en la producción hospitalaria. **Métodos:** Estudio descriptivo y comparativo entre costos de ambas modalidades de hospitalización de NANEAS de alta complejidad. De enero a diciembre 2016 se registraron hospitalizaciones NANEAS no oncológicas del Servicio de Pediatría (SP) según norma del Ministerio de Salud-Chile (MINSAL). Se clasificó para grupos clínicos y consumos similares de recursos según grupos relacionados al diagnóstico (GRD). Para evaluar el impacto en la producción hospitalaria la estancia fue ajustada y se realizó un análisis financiero de ambas modalidades (AC y HD). **Resultados:** De 3690 egresos, 126 (3,4%) se relacionaron a 27 NANEAS, la edad promedio fue 4,6 años (± 5 DS) con dependencias tecnológicas para vivir. La estancia media NANEAS fue 16 días, comparada con 5,9 de los pacientes sin necesidades especiales en salud. Las estancias NANEAS llegaron a 2017 días (8,6%). Prescindir de los egresos NANEAS hubiera aportado 320 egresos adicionales y su HD habría ahorrado US \$15/día por paciente, que para el total de estancias consumidas habría sido un ahorro anual de US \$ 29 170. **Conclusiones:** La HD tiene un costo estimado menor a la AC de NANEAS de alta complejidad, mejora la productividad hospitalaria y libera camas críticas con inversión financieramente viable.

Palabras clave: Enfermedad crónica terminal; Costos de atención en salud; Servicios de Atención de Salud a Domicilio; Hospitalización (fuente: DeCS BIREME).

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INTRODUCTION

The Chilean health insurers, public (FONASA) and private (ISAPRES), do not classify codified benefits for models of hospitalization at home (HH) or other solutions for home reintegration for children or youth with special needs in health (CYSHCN) nor adults. This shortcoming is felt in patients with greater complexity, especially with technological dependencies to live, who are susceptible to being investigated by management models during hospitalization⁽¹⁾.

In public coverage, there are ministerial programs linked especially to the secondary level of care for patients with oxygen dependencies and home ventilatory assistance⁽²⁾. Despite the success and growth of these programs, they include only specific coverage without considering other requirements. Recently in Decree No. 50, of 2016, effective as of January 1, 2017 (Law No. 41646. Official Gazette of the Republic of Chile, Santiago, Chile, December 30, 2016), home enteral nutrition has been included in the benefits insured by Law 20850, Ricarte Soto Law, being in the implementation stage.

Other coverage related to technological dependencies, such as cardiorespiratory monitoring, tracheostomy, parenteral feeding, are not covered. These elements, plus a demand that exceeds the real supply, limit the possibilities of hospital discharge and, in addition, can impact hospital productivity.

FONASA has designed coverages with specific HH encodings in acute or subacute patients. This tends to solve the medical or surgical hospitalization requirements in those with treatments or other health interventions with clear objectives to fulfill in limited coverage times once they are discharged from the hospital.

These traditional glosses of acute/subacute HH models defined in patients with basic or medium complexity exclude patients who require continuity of prolonged or permanent care.

This is how CYSHCN, especially those with greater complexity and technological dependence, are currently excluded from home care with a regular source of financing. This violates them from the economic perspective and due to the burdens of care, social and damage to the quality of life for them and their families^(3,4).

In ISAPRES, financial support for HH is generated through the activation of additional coverage

for catastrophic illnesses (CAEC) included in the insurance or through extra-contractual agreements, which are usually partial and discretionary; always from the payer's biased perspective. HH for chronic diseases was excluded from CAEC coverage until 2017. That year this situation was reversed by the provision of the Superintendency of Health of Chile, considering that it was a discriminatory practice linked to the health condition of the people⁽⁵⁾.

The extended hospital stays of CYSHCN of high complexity generate negative indicators of clinical management for the insurer. This is due to many missed discharges, especially in epidemic periods with a greater need for hospitalization, especially during the winter. The mean stay of these patients is around 100 days, and they frequently exceed one year of hospitalization⁽⁶⁾.

There is a need to generate management indicators and specific results for a global program of care for highly complex CYSHCN patients that allows focusing resources. It was suggested that the modality of caring for these patients be analyzed from the payer's financial perspective, which is more cost-effective. It can increase hospital productivity in highly complex pediatric centers.

HH and CC, the set of care and inputs contributions (basket), health personnel, and necessary equipment of each case were considered to compare both modalities.

In this context, the main objective of this study was to compare the estimated cost of HH of high complexity CYSHCN versus the real cost of CA in hospitalization and its impact on hospital production.

METHODS

The study was descriptive and compared the hospitalization costs of highly complex CYSHCN patients in the hospital setting versus the costs that this patient would generate at home. The data collected was between January and December 2016. The total of CYSHCN patients of high complexity from the Pediatric Service (SP) discharged during that year were included. An estimate was made of the costs associated with these patients in relation to the total discharges from the SP and the costs that these same CYSHCN patients would have generated in the condition of home hospitalization. The patient complexity categorization was done under the MINSAL clinical classification criteria^(7,8). The characterization of syndromic diagnoses was

also included.

To determine the total cost in CA, the complexity analysis methodology was considered, using the weighting of the institutional base price by the relative weight of the DRG (groups related to the diagnosis) at the patient's discharge. GRD is a system for calculating hospital reimbursement based on values given by a relative weight of the encoding of discharges^(9,10).

The cost is based on the days of stay consumed by the hospitalized patient in beds of medium and intermediate complexity of the SP.

The information on the DRGs was obtained from the Management Control Unit and the DRG Clinical Analysis Unit, IR-GRD version 3.0. Adjusted to the standard based on national hospital discharge information, called the MINSAL_2014 IR 3.0 Standard (Oracle Corporation ®; California, USA) (IASIST ®, Santiago; Chile) and cost information (resource consumption) through the statistical tool WINSIG ® (Pan American Health Organization ®; Washington DC; USA).

The costs associated with home care, as they correspond to open care, are not included in the DRG, so they were calculated through the evaluation of financial feasibility for the investment in equipment, using the criterion of net present value (NPV). VAN is a way of evaluating investment projects, which calculates the current value of a certain number of future flows and discounts them at a relevant interest rate. For this, all cash flows at present were used, discounting them at an interest rate of 10% per year. A table of estimated flows over five years was made that considered assumptions, which for our analysis were a nominal annual increase of 12% over the initial investment. In the same way, growth in the number of active patients (cared for) of 10% per year and an average annual stay of 150 days was estimated. The equilibrium price and the moment (year) when the investment is recovered were calculated. The equilibrium price is understood as the minimum price that allows a project to be financially viable.

For the purposes of this review, the clinical behavior between the general of the PS patients and the group of highly complex CYSHCN patients was compared.

For the analysis of compared costs, the decision was made to compare the total prices between both modes of care, consisting of direct costs generated by HH. That is, they are only recorded to

the extent that the specific service to be evaluated is performed, and they are, therefore, strictly linked to the services delivered at home. Indirect costs are not considered in HH because they are only attributable to the exercise of benefits in closed care due to the consumption of hospital resources. HH direct costs include those determined by the initial investment of the equipment with an estimated five-year depreciation. Plus, other direct costs are determined by home benefits performed by medical and non-medical professionals at the patient's home. According to specific baskets, the equipment is considered elements for home use for ventilatory support and enteral nutrition by nasogastric tube (NGS) and gastrostomy.

Those direct costs were determined by absorption costing, considering, therefore, the totality of those generated throughout the hospital stay. The total costs obtained correspond to the costs (WINSIG) associated with the complexity derived from the DRGs. Given the difficulty in being specified, the indirect costs are estimated by the difference between the total and direct costs.

The costs were expressed in US dollars considering the price of the dollar observed during January 2017; according to the conversion, it corresponded to 1US \$ = 646 Chilean pesos.

The total discharges of the highly complex CYSHCN patients were compared with the total number of discharges from the SP. They are the ones usually admitted to HH, forming part of the follow-up database. For the analysis of hospital stays and complexity characteristics expressed in GRD weight, the Student's t-test was used as a statistical test with different variances. The total days of hospitalization and the total number of discharges were analyzed. The stays of high complexity CYSHCN patients and of the rest of the patients were evaluated in ranges of days in 0-1, 2-4, 5-7, 8-14, and 15 or more days.

To evaluate costs by DRG, the following metrics were considered for the analysis of the clinical behavior of patients in CA:

Mean weight (PM) DRG: It considers the relative weight of each DRG and the global mean cost as a value. Thus, the PM GRD is the numerical expression of an average patient's relative consumption of resources for a particular GRD. These resources refer to the stay (days of hospitalization) and the estimation of resources to resolve the event. High values of Relative Weights represent more complex



DRGs, since the PM is closely associated with the Casemix Index, which measures the different degrees of the relative complexity of the casuistry of a center with respect to the standard in terms of room consumption. Each patient is assigned to only one DRG (the system is mutually exclusive) according to their coded clinical history^(8,9). For the payment, a national base price (PBN) was mathematically defined, and the payment of the hospital activity to the establishments is made according to Base price x casuistry.

Average Stay (ME): Average days of stay of the total of valid registrations. They are calculated for each GRD and level of complexity. MS reflects the time when a patient is admitted to the hospital until he is healthy enough to be cared for in his usual environment. It is mainly an indicator of resolution that measures the speed with which the hospital develops plans for diagnosing and treating diseases. This indicator also allows a vision of the clinical effectiveness since the complications, and associated adverse effects can prolong the stay.

Expenses: Total number of discharges attended. Outliers are defined as those whose EM is below or above the cut-off points calculated for each DRG; Upper outlier is the number of cases whose stay is above the upper cut-off point, and lower outlier, the number of cases whose stay is below the lower cut-off point.

Hospital Production Units (UPH): This allows you to measure and compare hospital activity or production. It is calculated as the sum of the production quantities (expenditures) multiplied by the specific value of that product (relative GRD weight). UPH achieves the grouping or classification of cases. Its particularity is that it allows the codification, measurement, and analysis of all hospital activity, including outpatient, hospital, and major and minor outpatient surgical procedures discharges.

Base Price (PB): obtained for the year of cost (WINSIG) associated with complexity (GRD).

The project was presented and authorized by the Scientific Ethics Committee of the Central Metropolitan Health Service.

RESULTS

Between January and December 2016, the SP presented 3,690 discharges with an ME of 6.3 days.

For this period, 228 patients with special health

needs were discharged regardless of their clinical complexity, 53% male, with an average age of 4.6 years (± 5 SD).

Data from 126 discharges (3.4% of the total for the period) were analyzed, generated by 27 patients clinically categorized as CYSHCN of high complexity (11.8% of all patients with special health needs), who had conditions for be cared for in open care with home hospitalization and presented technological dependencies to live (invasive and non-invasive ventilatory support for prolonged mechanical ventilation, enteral or parenteral feeding and vital monitoring at home).

Their average age was 5.6 years (± 5.6 SD). Considering the total discharges generated, their ME was 2.7 times greater than the ME generated by the rest of the pediatric patients, 16 days compared to 5.9 days.

The complexity of the CYSHCN The main diagnoses are broken down in Table 1 and the main technological dependence in Table 2. It is observed that oxygen therapy and ventilatory support were the most prevalent, followed by the use of devices for enteral feeding.

The complexity of care. The complexity of the SP was 1.01 (0.14 times more complex than the hospital complex as a whole). Table 3 compares the complexity of the highly complex CYSHCN discharges and the rest of the pediatric discharges, with statistically significant differences ($p < 0,01$).

Length of stay. In CYSHCN the most frequent range of stay is from 0 to 1 day with 46.1%, which corresponds to patients who are admitted to the hospital only for nocturnal parenteral nutrition (ALPAR). Stay range of 2-4 days corresponded to 15.6%, 5-7 days 10.2%, and 8-14 days with 6.3%. The second most frequent range of stay is 15 days and more, corresponding to cases that are admitted due to the need for ventilatory support with 21.9%. The total consumption of high complexity CYSHCN stays totaled 2017 days (8.6% of the total stays consumed by pediatrics). Table 4 compares the days of hospital stay for high complexity CYSHCN versus the total SP, with significant differences ($p < 0.01$). Outlier discharges, in addition to presenting a great contribution to complexity, with an average DRG weight of 3.5, presented a very high mean stay (99.8 days). The maximum observed for the 2016 period reached 243 days. In the upper outlier cases, the ICD-10 code z99.8 "Dependencies on other machines and

capacitive devices" was frequently associated, within their prolonged stay and, generally, originated in the requirement of equipment for prolonged mechanical ventilation and infusion pumps for feeding. By 2016 it was observed that 75% of the CYSHCN had presented this condition.

Impact on hospital productivity. If the 126 highly complex CYSHCN discharges had been dispensed with, and thus the days spent in their stays, potentially 320 discharges would have been obtained (adjusted to the SPa characteristics: GRD weight, average stay). During the seasonal epidemic outbreak of respiratory diseases in winter (Winter Campaign Program of MINSAL of the Chilean government), when the occupation of the SP is practically complete, there were 534 discharges, with an average GRD weight of 0.9, ME of 7, 4 days and spent stays of 3,963 days. With the number of days spent in hospital stays by the CYSHCN group and adjusted to the MS of the winter campaign, 272 potential discharges would have been obtained. That is, if the hospitalization of CYSHCN discharges had been dispensed with, it would have been possible to hypothetically attend to 50.9% of the total cases of the winter campaign (Department of Management Control and the Unit for Analysis of Clinical Records - Groups related by Diagnosis (GRD) and institutional cost control system WINSIG[®] (Pan American Health Organization[®]; Washington DC; USA).

The SP's higher outlier discharges (those with a stay greater than the upper limit of the MINSAL 2014 standard) reached 4.5%, with 166 discharges. Of them, 13 were CYSHCN (7.83%).

Cost estimate. The determination of the total cost

considered the weighting of the institutional base price by the relative weight of each of the 27 complex cases. The CP of the HCSBA for 2016 amounted to US \$ 4,115, and the relative weight of the hospital DRG was 0.9. The total annual cost for the 27 high complexity CYSHCN was US \$ 440 343. For the project, its monthly calculation was US \$ 36 695.

The comparison of costs of patients in home hospitalization versus closed hospitalization can be seen in Table 5. Within the direct costs, HH includes those determined by the initial investment of the equipment with an estimated five-year depreciation of US \$ 1,680 / month. Daily HH costs are estimated at US \$ 26, which, in closed care, amounts to US \$ 45. In this way, HH would have, in comparative costs, a difference with the hospital equivalent to US \$ 19 / day per patient. For stays consumed in 2016 of 2017 days, it would determine an average annual saving of US \$ 39,104.

HH's proposed strategy requires an initial investment in equipment of US \$ 100,774. The five-year financial evaluation determined a financially viable project with a positive NPV and equilibrium price of US \$ 65. This is supported by the Valued Benefits (PPV) of the comprehensive pediatric home hospitalization bed days in an Intermediate Treatment Unit (US \$ 178), or complex home comprehensive hospitalization bed days of the acute pediatric patients (US \$ 187). The investment is recovered in the third year (Management Control Department and the Clinical Records Analysis Unit - Diagnosis Related Groups (DRG) and institutional cost control system WINSIG[®] (Pan American Health Organization[®]; Washington DC; USA)).



Table 1. High complexity CYSHCN main diagnosis.

Diagnosis	n°	%
Neurological (cerebral palsy with refractory epilepsy)	17	63,0
Respiratory Chronic lung damage (n = 3) Cystic fibrosis (n = 1)	4	14,8
Genopathies Down syndrome / trisomy 13	2	7,4
Short intestine	2	7,4
Chronic kidney disease	1	3,7
Crigler Najjar syndrome	1	3,7
Total	27	100,00

Table 2. Highly complex CYSHCN technological dependencies. January - December 2016.

Main technological dependence	n°	%
Chronic parenteral feeding	2	7,4
Gastrostomy	15	55,6
Oxygen therapy	17	63
Non-invasive ventilatory assistance	14	51,9
Mechanical ventilation through tracheostomy	8	29,6

Table 3. The complexity of discharges (GRD weight) of 27 highly complex CYSHCN versus discharges of the rest of the patients.

Patient type	Total group	Mean	Standard Error (SE)	Range (mini- mum-maximum)
DischargesCYSHCN high complexity	126	1,84	0,16	0,1-11,7
No CYSHCN	3564	0,98	0,02	0,1- 12,4

P<0.01



Table 4. Days stay in pediatrics for high complexity CYSHCN versus non-CYSHCN patients.

Patient type	Total days hospita- lization	Mean	Standard Error (SE)	Range (mini- mum-maximum)
High complexity	2017	16,01	3,2	0-287
No CYSHCN	21 339	5,99	0,2	0-187

P<0.01

Table 5. Comparison of costs (estimated) of the monthly care of CYSHCN with technological dependence, home hospitalization, and closed care.

Type of cost	H. Domiciliary (US \$)	H. Closed care (US \$)
HR costs	17 586	3400
Depreciation purchase HH equipment (venti- latory support and enteral nutrition)	1680	0
Basket of supplies	1726	2725
	Relevant	Absorción (2)
Total direct costs	20 992	61 236
	Not Applicable *	(Difference 1-2)
Indirect costs	0	30 570
TOTAL COST 27 patients	20 992	36 695
	Relevant	Winsig GRD (1)
Cost per patient	778	1359
Cost per patient per day	26	45

HH: Home hospitalization
(*): Only costs are considered relevant, which are those that completely depend on the decision to execute Home Hospitalization.
For the conversion to the observed dollar (Chilean pesos per US \$ 1 = 646), the price of the dollar observed during January 2017 was used.





DISCUSSION

HH home hospitalization constitutes an activity that can and should be evaluated by different quality indicators, which have recently been approximated from the nursing perspective, focused on demonstrating efficacy, efficiency, and safety in the care of users^(11,12).

However, even though the implementation of HH implies rethinking paradigms, models, and traditional concepts of care^(13,14), there are no economic evaluations that allow answering whether the objectives set for HH, such as optimizing CC recourse to the bed in favor of early exit to HH, achieve to minimize hospital care costs, transforming into a sustainable alternative implementation⁽¹⁴⁻¹⁸⁾, let alone in population. highly complex CYSHCN

To our knowledge, this is the first Latin American study to analyze CYSHCN financial burdens from the perspective of the public insurer, and, naturally, it is prudent to analyze its strengths and weaknesses. In the analysis of modern health care, the economic perspective is very important and becomes very powerful when it has value backing. The experience of this study opens a methodological path to specify the financial aspects of at least two ways of caring for CYSHCN, hospitalization and home care. It is possible that, in addition, what has been learned can be used to study the economic aspect of these children at the time of their hospitalization.

From an economic perspective, there is an experience in the US and Europe regarding CYSHCN in groups with similar diagnoses and home care groups, evaluating direct and indirect costs, expressed as "costs of the disease"^(1,4). Some studies analyze patients with spinal atrophy (19) and Duchenne muscular dystrophy⁽²⁰⁾, to the financial burden of long-term ventilatory assistance at home, comparing ventilation through tracheostomy and non-invasive ventilatory support⁽²¹⁾. We are unaware of published studies that point to comparative costs and analyze the impact on hospital productivity. In this way, this work can propose a form of analysis of the topic and be useful in its decisions⁽¹⁾.

In this study, possible weaknesses are associated with a possible bias in costs, considering only those direct to the payer (insurer) and the possibility of underestimating family costs incurred at home.

There are also no evaluations of the quality of life of the patient and his family or a complete study from the perspective of cost-effectiveness / cost-utility; as

has been done in other chronic diseases (childhood asthma), when evaluating pharmacological intervention strategies⁽²²⁾.

The possible undervaluation of costs is associated with HH interventions with a lower amount than that reported internationally, especially for patients with prolonged mechanical ventilation, either with invasive mechanical ventilation or non-invasive ventilatory assistance^(20,21). Other considerations would be those related to comparing measurements based on DRG for hospitalized patients and estimation of direct/relevant costs for HH.

Indeed, due to the cost structure of closed health institutions, the general indirect costs that must be included are difficult to quantify and link with the work of an area or the production of a service, which, as in the case of our analysis, they are high. For the specific case of the necessary benefits in our CYSHCN patients of high complexity in stable condition and prolonged stays in bed of medium or intermediate complexity, they are equivalent to more than 2/3 of the total expenses.

This difference in the estimation of the costs of both forms of care and that allows for the exercise of HH to have only direct and relevant costs, explains the favorable budget execution at almost half of the costs in closed care (CA), which should include the entire burden of the consumption of hospital resources.

The difference in compared costs adds to the advantages of the HH model as a form of care of choice for complex CYSHCN, even when only biased considerations are made from the perspective of the payer and none of the patient and their families. In addition to the robust financial factor presented, there are benefits for patients in other dimensions that were not addressed in this writing. Perhaps the most important among them is the non-financial added value reported by home treatment from a sociocultural, ethical, and quality of life perspective⁽²²⁻²⁶⁾. It is also important to mention the positive effects from the perspective of health objectives and outcomes.

Our results suggest that highly complex CYSHCN managed adequately in HH determines economic savings over time due to significantly longer hospital stay and complexity, according to DRG, preventing non-elective hospitalization events.

Thus, the financial analysis of the results obtained suggests that the implementation of HH in the

public health system could be viable and have a rapid financial equilibrium with returns, rather than through institutional services valued MINSAL for HH, including glosses Specific CYSHCN in the discharge diagnosis, which allows grouping this set of long-term and complex medical conditions in a more accurate way than the clinical characteristics contained in DRG. In such a way as to generate coverage equivalent to the improvement of hospital productivity.

Thus, the natural setting for these patients can be their home with their family's support network, generating early transfer strategies to the home that avoid prolonged hospitalizations⁽²⁾. However, patients and families require appropriate empowerment, education, and training to consolidate this outcome safely. Considering in the

process the dynamics, rhythm, and functionality of each family in particular⁽³⁾.

HH seems the best strategy to deliver organized care in a prolonged way in CYSHCN of high clinical complexity, where the costs of CA constitute questionable financial burdens from a technical and ethical dimension. On the contrary, HH empowers and optimizes joint work with the family, balancing the principles of beneficence and justice, by providing partial government financing, according to what is socially acceptable and possible⁽²⁶⁾.

CONCLUSION

This study suggests that HH presents not only a lower cost compared to CA of high complexity CYSHCN but that this way of caring improves hospital productivity with a financially viable investment.

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